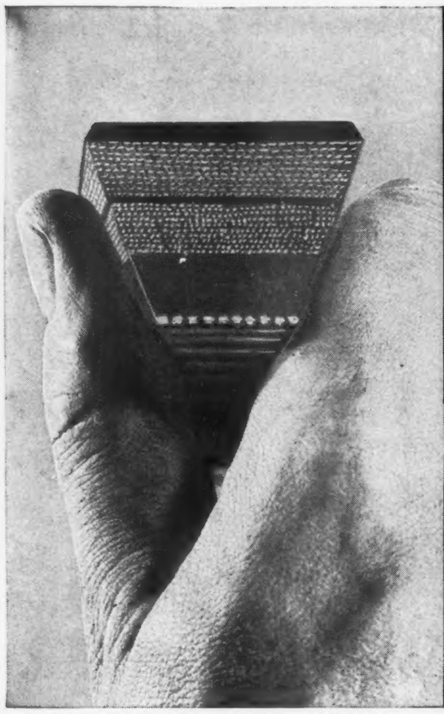
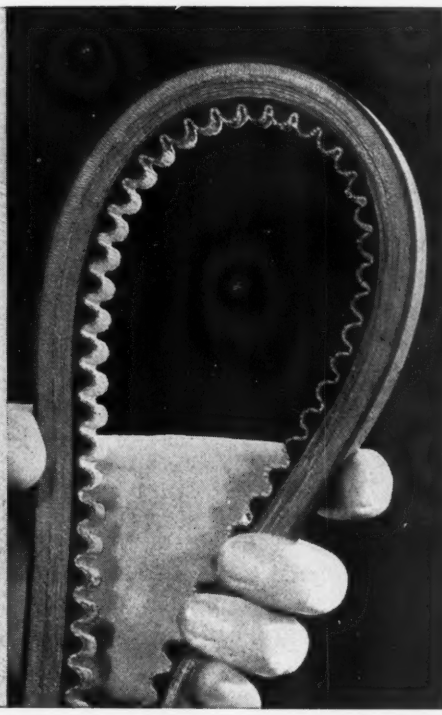
Compressed Air Magazine

Vol. 39, No. 9 London - New York - Paris September, 1934

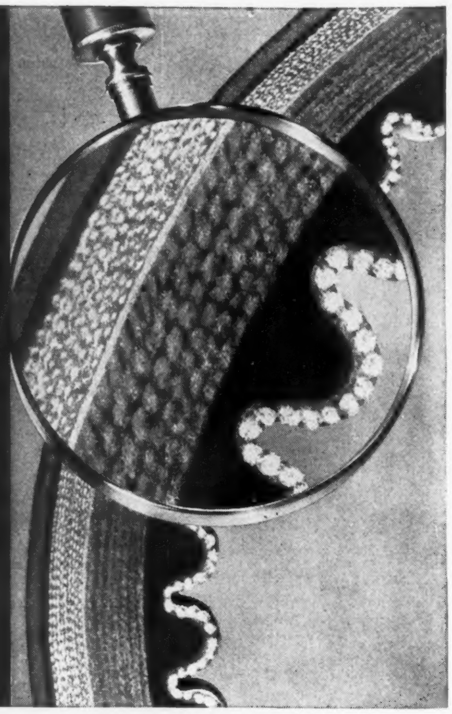
WAGON DRILLS ON A STEEP SIDEHILL ROAD JOB



EXTREME CROSSWISE RIGIDITY
No other V-Belt combines such positive crosswise rigidity with such extreme flexibility.



BUILT TO BEND
See how the "cogs" take up the compression on the inner surface of the belt.



GREATER GRIPPING POWER
Sides die-cut—not molded—with raw edge contact surface, give greater gripping power with less tension.

COMPARE

THE DAYTON COG-BELT WITH ANY OTHER V-BELT IN VITAL PRINCIPLES OF CONSTRUCTION

Considering how it is made and what it does, the Dayton Cog-Belt is without a rival in the V-Belt field. Back of it are advanced principles of design and construction which result in superior performance, longer life, and lower operating and maintenance cost.

First, it is the only V-Belt specifically *"built to bend."* Its patented cog and laminated construction provide far greater flexibility . . . enable it to flex easily around even the smallest pulley without buckling or rippling.

And while it is more flexible, its laminated construction and patented reinforcement give it *extreme crosswise rigidity*. There's no squashing in the pulley groove . . . no distortion nor twisting. No other V-Belt combines such extreme flexibility with such positive crosswise rigidity.

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A Monthly Publication Devoted to the Many Fields of Endeavor in which Compressed Air Serves Useful Purposes

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Compressed Air Magazine

SEPTEMBER 1934

Volume 39 Number 9

EDITORIAL CONTENTS

ADVERTISING INDEX

Annual subscription rate: Domestic, $3.00; Foreign, $3.50. Single copies, 35 cents.

Manuscripts intended for editorial consideration should be accompanied by return postage.

Photo, R. T. Jackson

TENNESSEE SCENERY AT ITS BEST

One of the many enticing views that unfold before the traveler from Gatlinburg to the summit of the Great Smoky Mountains. In the background is Mount LeConte, declared by Horace M. Albright, when director of the National Park Service, to rank with Pike's Peak, Rainier, and other world-famed mountains. Although exceeded in altitude by two other peaks in the Great Smoky uplift, its elevation of 6,593 feet makes it the highest point in Tennessee.

Bringing the Great Smokies Closer ------

R. G. SKERRETT

ARTISTIC MASONRY BRIDGES

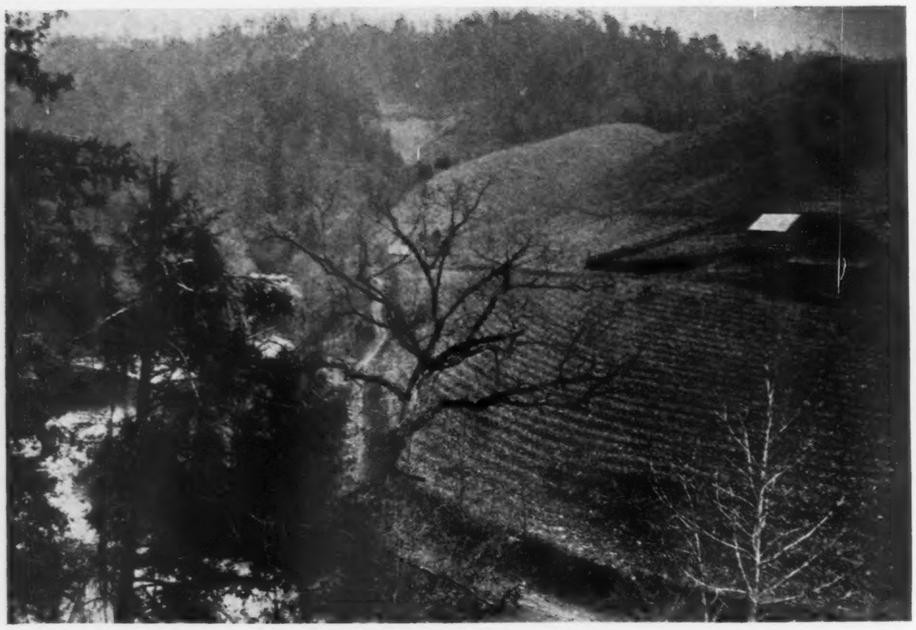
Drainage structures are marked by studied design and expert workmanship. The accompanying pictures show how one of these native-stone bridges appears from above and below. These views were taken between Smokemont, N. C., and Newfound Gap.

WE ARE "quar"; we are "different"; we are "furriners"—more than 100,000,000 of us, despite the fact that we were born here! At least, that is the way we are classed by most of the long-established and virtually unchanged inhabitants of the Great Smoky Mountains. Strange as it may seem, those secluded mountaineers have much to justify their point of view. They have a background that makes them prideful; and, judged by their standards, we are alien in many ways and so different in some particulars that the term queer is not ill chosen.

Why should these mountain people be of present interest? Because, as a nation, we have lately acquired an expansive area in a region that has been occupied by them and their forebears for five or six generations; and these southerners reflect the environment in which they and their kind have lived apart all that while. Before we tell more about these people of fine heritage, let us touch upon developments in that region that concern all of us. Then we can harken back to the days when those highlanders of the South made their way into the depths of the Great Smokies and found in that wilderness conditions in harmony with their spirit of independence and their desire for untrammeled self-expression. Those pioneers accepted hardships as a matter of course; and their descendants have done generally likewise in the succeeding decades.

In November, 1930, the then Secretary of the Interior, with befitting ceremony, accepted from North Carolina and Tennessee 138,843.2 acres of land situated in the very heart of the Great Smokies. Earlier in that year the same states had made a gift of 158,876.5 acres to the nation. Thus, through the patriotic and generous efforts of the two commonwealths, the Government was put in possession of 297,719.7 acres in a scenically wonderful section of our country. The Great Smoky Mountains National Park, which has been approved by Congress, will become a legal entity, and will be administered by the National Park Service as soon as enough additional land is turned over to the Federal authorities to constitute a single reservation of 427,000 acres. Progress to this end promises the early consummation of the project, and in the meanwhile the two states directly concerned and the Government are collaborating in making the region more accessible by the construction of splendid highways.

Every summer many thousands of Americans in the eastern half of the country journey to the Adirondacks, to the White Mountains, and to lesser aggregations of imposing hills in the belief that they are visiting the most impressive of the mountain systems within their reach. They are apparently unaware that there are other mountain ranges relatively near them that are far grander in every way and richly endowed with unique charms. We refer to the Appalachian system, which has been presented to the world at large in a sympathetic and authoritative manner only within the last twenty years.



TYPICAL MOUNTAIN FARM

Cultivation of steep hillsides such as this in a region of heavy rainfall is a losing battle, as the arable surface is rapidly washed into the valley bottom.

The Great Smoky Mountains constitute the master chain of the Appalachians which extend without a break from Virginia to Alabama. They lie on a line that runs from northeast to southwest and cover a distance, as the crow flies, of 650 miles. The mountains occupy parts of eight states; and the ground area of the system is about equal to the combined expanse of New York and New England. This magnificent aggregation is nowhere more than 250 miles inland from the Atlantic; and in the higher sections blankets are needed at night the year round.

The truly splendid magnitude of the Great Smokies and their associate ranges has thus been summed up by the late Horace Kephart: "In all the region north of Virginia and east of the Black Hills of Dakota, there is but one summit—namely, Mount Washington in New Hampshire—that mounts 6,000 feet above sea level, and there are no more than a dozen others that exceed 5,000 feet in altitude. By contrast, south of the Potomac, there are 46 peaks, and 41 miles of dividing ridges, that rise above 6,000 feet, besides 288 mountains and some 300 miles of divide that stand more than 5,000 feet above the sea. In North Carolina alone the mountains cover 6,000 square miles, with an average elevation of 2,700 feet, and with 21 peaks that overtop Mount Washington."

The foregoing figures tell a story of vast proportions, but they fail to convey an idea of the physical difficulties encountered in seeking to blaze a way from east to west across the system. The major ranges parallel one another much like a sequence of tremendous waves. Their slopes are for the most part covered with exceptionally dense stands of fine timber; and over far-flung areas these forest monarchs rise from tangled undergrowths of laurel and rhododendron so thickly intermeshed that a man can walk upon them and be his own height or more above the ground! In some of the valleys between the dominating ranges are confused jumbles of lesser hills that run in all directions like a choppy sea and form labyrinths that are virtually impassable to all but the informed inhabitants of the region. Such being the nature of the country, it is not hard to understand how a people dwelling there could be lost to the rest of the world and out of touch with the activities of the nation as a whole.

The Great Smokies, like the remainder of the Appalachian system, were geologically old when the Rockies and other mountains on this continent were formed. Indeed, they are among the most ancient of the world's mountains. Because of this, and because they have survived in the main unaltered through ages, the Great Smokies are extraordinarily rich in those things that appeal to the nature lover. The trees and other growths that cloak the upheaved shoulders tell the story of a development that has gone on for untold centuries; and something of the mood and the mystery of these immemorial hills has influenced the mountaineers ever since the first of them settled there.

The original pioneers were mostly Scotch-Irish that came to America after the Antrim evictions and at first took up lands westward of the German settlements in Pennsylvania. Some time early in the eighteenth century a considerable number of them migrated southward, following the valleys of the Appalachian system. They were a sturdy, determined lot of a fighting type peculiarly fitted to deal effectually with the Indians who had previously menaced the westward movement of the white man. Their desire was to get as far as possible from organized government, because their minds were still filled with bitter thoughts towards the authorities who had caused either them or their immediate forebears to flee Ulster.

The Scotch-Irish element, while in Ulster, learned from the native Irish how to fashion and to operate small stills; and the practice of producing illicit liquor was, in due course, thus transplanted to the uplands of the mountainous parts of North

WHERE SLAVES RESTED

This old house, which can be seen from the Smokemont-Newfound Gap road, served during the Civil War as a resting place for slaves being run secretly to freedom over the mountain range into Tennessee.

Carolina and Tennessee. Corn grown on the cleared and precipitous slopes of the hills became a source both of food and drink, and served the double purpose of medication and stimulation—even infants being soothed with the liquor. The mountaineer quite naturally came to think that he had an inherent right to make whisky for himself and his family; and one has but to see those people in their isolated settings—scantily clad and often ill-nourished amid a rigorous environment—to appreciate the part that spirits have played in neutralizing exposure and in making the natives forgetful, for a while at least, of the harsh circumstances of their existence. So much for the origin and the persistence of "moonshine."

When the forefathers of the present mountaineers made their ways into that wilderness, they carried with them the social characteristics, the speech and folk-lore, and the point of view of English-speaking people of the seventeenth and eighteenth centuries. In many respects the sequestered inhabitants of Appalachia are today what their original stock was in the generations gone; and this makes them all the more interesting not only as living examples of a distant past but as contrasts by which to judge ourselves of today.

The mountaineer does not accept us at our own valuation. He is decidedly set in his conservatism; and a large percentage of the grown-ups is strongly opposed to change. The true native may be ill-clad and lacking in many creature comforts, but he boasts that he has never been anyone's hireling. He will tell you that most "silly, stuck-up strangers" are in some degree other men's servants. The population of the whole of Appalachia probably does not exceed 3,500,000; but of that number fewer than 20,000 are said to be of foreign birth. According to Kephart: "This same odd people is more purely bred from old American stock than any other element of our population that occupies, by itself, so great a territory."

Even though these mountaineers have never acknowledged any superiors, and have pretty generally refused to take orders, still their stalwart patriotism has been amply proved. During the Civil War, 180,000 of their sharpshooters voluntarily cast their lot with the Union cause—to the astonishment of both the North and the South; and how splendidly and effectively they fought is a matter of indisputable record.

And why, the curious will ask, should these highlanders of the South have remained so much like their forefathers while the rest of the nation swept forward on the tide of progress? The answer is: The inaccessibility of much of the territory in which they have lived for so long. Only latterly have roads reached into the hinterland over which a wheeled vehicle could be drawn; and still more recently have hard-surfaced highways been built for motor cars and trucks. Most of the old roads have

ROUGH GOING

Treading an insecure footing, this powerful steam shovel is extending the foundation for the Smokemont-Newfound Gap road along the bank of a swiftly running stream.

been little more than trails that could be traversed only afoot or astride a horse or mule. They have commonly followed the rocky courses of mountain streams that might be virtually dry one hour and raging torrents a little later the same day. These mountain dwellers have brought up their families often but a few miles away from other mountaineers without ever becoming acquainted with one another; and what they have not had in the way of bare necessities they have stoically done without. Why intervening ridges have kept neighbors apart can be comprehended by this native characterization of the countryside: "Goin' up, you can might' nigh stand up straight and bite the ground; goin' down, a man wants hobnails in the seat of his pants." A terrain like this is not calculated to promote social intercourse. No wonder the mountaineers have stood still in a sense while the rest of the nation was carried by and around the foothills of Appalachia in the general tide of advancement.

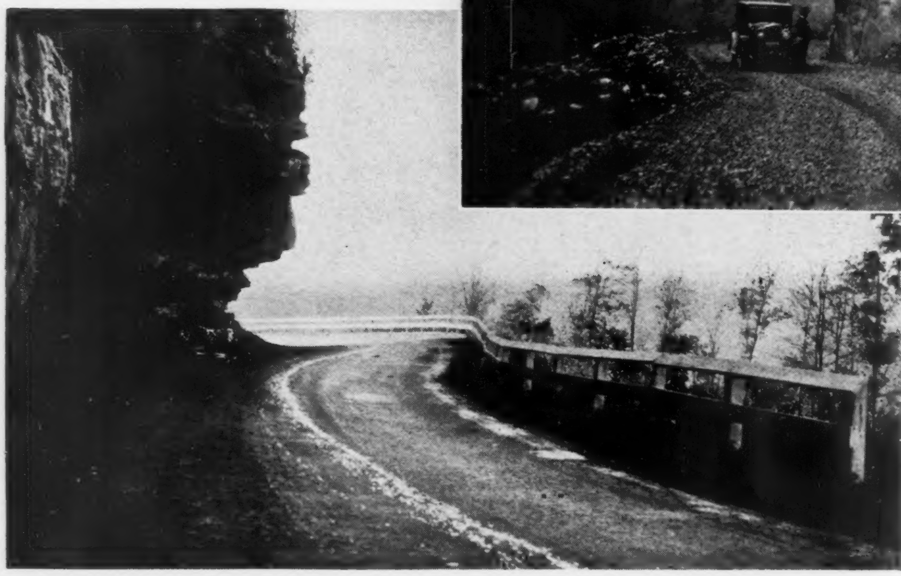
Of the great mass of the sequestered natives of Appalachia, John Fox has written: "People who have been among the southern mountaineers testify that, as a race, they are proud, sensitive, hospitable, kindly, obliging in an unreckoning way that is almost pathetic, honest, loyal, in spite of their common ignorance, poverty, and isolation. That they are naturally capable, eager to learn, easy to uplift. Americans to the core, they make the southern mountains a storehouse of patriotism; and in themselves they are an important offset to the Old World outcasts whom we have welcomed to our shores."

Slowly, but surely, leaders among the mountaineers are being developed; and vocational schools are teaching the women and the girls handicrafts that stimulate artistic taste and enable them to earn in a self-respecting way wages that give them the means to obtain some of the comforts of life so long denied them. Inevitably, the mountaineers will change, in fact are being changed, as they are caught up from the social eddies in which they have moved and are swept into the general current of the nation's onward tide. Let up hope that in this newer order they will retain their many fine qualities and serve as a beneficial leaven by reason of their inborn steadfastness and other sterling attributes.

The Great Smoky Mountains are so named because of the well-nigh continual blue haze that blends, by imperceptible gradations, the towering shoulders of the range with the coloring of the sky. This softening effect is akin to a nearly year-round Indian summer. There is no time in a twelvemonth when the Great Smokies are lacking in arresting charm. The hills are beautiful in springtime when mountain laurel, rhododendron, azalea, dogwood, and other blooming bushes and trees cloak vast expanses of the mountainsides with a varied and vivid display. The summer months are no less alluring because they, too, glory in many blossoming things and a general richness of verdure. When autumn comes, nature again employs a lavish palette; and then the hills are clothed in reds and yellows and tawny tones of an indescribable color range. And when the short period of winter settles upon the land, the mountain slopes still retain their attractiveness and are intriguing besides because of the colorful rebirth that will soon again adorn them.

No fewer than 120 species of native trees flourish in the forests of the Great Smokies. Probably nowhere else in the temperate

HEAVY ROCK WORK
Much of the western approach to Newfound Gap rests on a ledge cut from solid rock. These pictures show the road as it appeared before the current realignment program was undertaken.



zone is there such a variety of timber of a merchantable age. Frequent rains and a rich soil, combined with long periods of unhampered growth, have made the stands magnificent and exceptional. Some of these have been cut over; but wherever areas have been so denuded they have been reforested by the Federal Government. This wonderland of nature's making is now, in part, being turned into a great national playground. How much the gift should be treasured can be realized only by visiting the region. Last year more than 375,000 people journied there; and, judging by its present popularity, it is estimated that the number will soon exceed 2,000,000 annually. The Great Smokies are not lacking in accommodations for the tourist, nature lover, and the hiker. Most of these facilities are located at or close to the boundaries of the reservation; and good roads run not only to the park limits but, at certain points, enter it and traverse it. The park area is about 65 miles long and from 15 to 25 miles in width.

About four years ago, the State of Tennessee built a fine motor highway from Gatlinburg up the neighboring mountainside to Newfound Gap, which is at an elevation of about 5,100 feet above the sea. The gap is on the dividing line between North Carolina and Tennessee and but a few hundred yards to the north of the old Indian Gap Trail of historic note. Since then, North Carolina has constructed a connecting motor highway that links Newfound Gap with Bryson City, N. C., thus providing a route directly across one of the most scenic parts of the reservation and skirting the base of the towering dome of Mount LeConte, nearly 1,500 feet higher than the gap.

Between Newfound Gap and Smokemont, N. C., the motorist can see, across a stream in the valley below, a dilapidated habitation that served during the Civil War as a resting place for Negro slaves that were being run secretly over the range to Tennessee and to freedom. In that old house the slaves were refreshed and made ready for the stiff climb to Indian Gap. The hastening motorist, today, scarcely realizes what the climb involved because of the engineering skill that has been exercised in locating the new highway.

The so-called Indian Gap Highway, which really runs to Newfound Gap, has a maximum gradient of 8 per cent. At some points it follows the old trail, but for the most part it blazes a new route well above the bottom of the valley and along a shelf cut out of the rocky mountainside. In that procedure we see how the modern roadbuilder departs from the practices of his fellow of the past, who was commonly content to parallel an existing watercourse, if one there were, and to pursue his way along the line of least resistance even though that might entail a very stiff grade from time to time. The highway engineer of the present proceeds differently. From end to end of a road both the climb and the descent must be such as not to overtax engines or to place too heavy a duty upon brakes. Therfore he has to cut and to carve through masses of earth and rock—to remove any obstacles standing squarely in the path projected after careful surveys. Further, he must try to fit his road as unobtrusively as possible into the landscape so as not to mar the scenic charms of the region traversed.

With the surveys made, the quantities of excavated materials and fills predetermined, and certain prescribed conditions taken into account, then proper equipment and a suitable working force must be provided to do the work. In constructing the highway over the Great Smokies between Gatlinburg on the west and Bryson City on the east, the responsible authorities of the two states concerned supplied their roadbuilding organizations with typically up-to-date apparatus. These included portable compressors, air-driven rock drills, drill-steel sharpeners, power shovels, and such other equipment as would aid in carrying the operations forward successfully and rapidly. It is because the roadbuilder of today has these facilities that he can go forward confidently and meet specified schedules even though nature interposes barriers and impediments that were formerly sidestepped. Incidentally, these same construction aids make it practicable to locate the roads where they will fit best into the landscape and at the same time give the traveler every reasonable chance to view the beauties of the countryside.

The author traveled the Tennessee section of the road one sunshiny day shortly after it was first built, and when the mountains were aglow in their autumnal dress. He is not likely to forget the sweetness and the exhilarating freshness of the breeze that blew in his face as he reached the crest at Newfound Gap. The air and the outlook were provocative of ecstasy. In this mood, he turned to his companion—also city born and also a city dweller—and exclaimed: "Do you imagine that the natives grasp the beauty of all this?" And his fellow answered, "I doubt it." Scarcely

five minutes later a motor car of a somewhat elderly model chugged slowly into sight and reached the top of the climb just before stalling. A white-haired mountaineer came forward in friendly fashion, and, after a greeting in the vernacular, said: "Isn't it fine? I've brought my daughter and my son-in-law from Kentucky up here for the view." Probably the vast majority of the inhabitants of the Great Smokies have much the same appreciation of the wonderland in which they live, but they are generally far less vocal about it.

The climb from Gatlinburg to Newfound Gap has had its thrills for the motorist, especially for the driver not accustomed to negotiating mountain roads that have hairpin curves and stretches where the highway rests upon a shelf overlooking a steep drop of a hundred or more feet. Since it was completed, traffic on the Gatlinburg-Newfound Gap Highway has become increasingly heavy, necessitating numerous improvements which are now underway. The work is being done by the National Park Service, and consists primarily of straightening the road wherever possible and of widening it to 30 feet. A 14-mile section is being given a surfaced pavement 20 feet wide; various changes in location are being made; and masonry walls are being constructed along its outer edge where the mountainside drops precipitously. Several tunnels are being substituted for the hairpin curves. These will be 30 feet wide, and the longest of them will extend for a distance of 300 feet. The rock formation penetrated by the latter lies at an angle of 60°, requiring heavy timbering throughout and, subsequently, a concrete lining.

Already a sum of $900,000 has been appropriated for these various improvements, and their ultimate cost is estimated at $1,250,000. The outlay will add immeasurably to the safety and to the peace of mind of all motorists, and will permit the traveler to enjoy just that much more the scenic wonders nature has provided in lavish abundance. The work involves approximately 45,000 cubic yards of excavating to the mile and the construction of 25,000 cubic yards of masonry retaining walls. John L. Humbard is in charge of the operations. He is senior highway construction supervisor for the U. S. Bureau of Public Roads which is handling the undertaking for the National Park Service.

The touring public should know what is being done for it to make available a region of varied fascination and one peculiarly rich in things calculated to appeal to the eye and to give pause to the thoughtful mind. In their physical characteristics, the Great Smokies are a veritable wonderland, and by reason of their range of altitude one can find on their slopes such forms of plant life as flourish between the latitude of Knoxville and a line lying well to the north of the boundary that separates us from Canada.

Photo, R. T. Jackson.

WHERE SMOKIES GOT NAME

Although our photographer chose one of the occasional clear days, a light-blue, dreamy haze customarily clothes the towering shoulders of the Great Smoky Mountains. It is this atmospheric phenomenon that has given them their name. This picture shows the "Chimney Tops," from which, so tradition has it, issues the soft haze that is so remindful of Indian summer.

Building the "Skyline Drive"

COPELAND LAKE

IN ADDITION to the highway relocation work described in the preceding article, the Federal Government is building a new connecting roadway which will further open up the rugged fastness of the Great Smokies. This route takes off from the main transmontane highway at Newfound Gap and runs southwesterly virtually along the very backbone of the range. Eventually, it will be extended along the crest of the mountain and tied in with the existing road system through Marysville and Alcoa and thence to Knoxville, thereby creating a circle trip from Knoxville that will afford motorists a glimpse of the true grandeur of the Smokies within a few hours' driving time.

The section now under construction is 7.6 miles long and has for its objective Clingman's Dome, the monarch of the Great Smoky range. This peak rises to a height of 6,642 feet, and is but 42 feet lower than Mount Mitchell, the highest point east of the Mississippi River. Newfound Gap has an elevation of 5,045 feet, and from it the new road will climb to its high mark of 6,300 feet on the shoulders of Clingman's Dome. For the most part it will lie in North Carolina, skirting the southern exposure of the upper reaches of the projecting peaks. Here and there along its line it will emerge upon the gaps formed by the dipping flanks of adjacent mountains and afford long-range vistas into both North Carolina and Tennessee. The name "Skyline Drive" which has been applied to it is aptly descriptive of its course.

This road will have a 7½ per cent compensated grade. It will be 30 feet wide, of

DRILLING FROM MOVABLE PLATFORMS

The power and economy of wagon drills was made available for work on steep mountainsides by constructing staging consisting of planks laid on 1-legged wooden horses, as shown at the right. Thus equipped, the contractor is drilling ground varying from solid rock to mixed bowlders and dirt at an average rate of 55 feet per hour per drill. Above is a short stretch of the pioneer road built at this point along a precipitous cliff by the aforementioned method of drilling.

which 20 feet will be surfaced. These are the minimum widths, as all curves are to be widened. The preliminary engineering was done by the U. S. Bureau of Roads, which agency is also in charge of its construction in behalf of the National Park Service. The work is being done by The Arundel Corporation, well-known Baltimore contracting firm, which secured the contract with a bid of approximately $680,000. Operations were started in October, 1933, and grading is to be completed by March 1, 1935. Exceptionally cold weather, during which the temperature ranged as low as 20° below zero Fahrenheit, necessitated a curtailment of activities last winter, but did not stop them entirely.

Most of the line traverses steep sidehill sections, a condition which calls for the excavating of an unusually large quantity of earth and rock to assure the required grade. All told, 450,000 cubic yards of material must be moved. This is an average of approximately 60,000 cubic yards to the mile, and places the undertaking among the heaviest road jobs now in progress in the United States. The foregoing figures likewise serve to emphasize the ruggedness of the area concerned. One-tenth of the total excavation, or 45,000 cubic yards, is localized at Newfound Gap, where there is being created a level area of sufficient size to park 500 automobiles. Earth and rock for this purpose are being taken from an adjacent slope, which has been cut back to such an extent as to transform it into an imposing cliff.

To the end that the natural state of the section may be altered as little as possible, rigid specifications have been applied to the work. Expert landscapers of the National Park Service framed the regulations concerning this phase of the operations, and the contractor is held strictly to them. Chief among these restrictions is the one that limits the road scar to a vertical range of 70 feet. Rocks and other material which are thrown outside of this zone by blasting must be retrieved. It is also specified that trees beyond the permitted scar lines must not be injured. In view of the steep slopes which prevail, it can be readily understood that these injunctions oblige the contractor to utilize extreme care at all times. So as to keep the scar within the designated limits, it is necessary in many places to erect retaining walls on the lower side of the roadway to support the toes of fills which would otherwise extend below the permissible line. In all, 20,000 cubic yards of rubble masonry will be required for this purpose. Trees which are in positions where they are likely to be struck by descending rocks are protected by binding about them vertically arranged timbers or small logs.

In order to open up as many points of work as possible and to establish grade throughout the length of the section, the contractor decided first to build a pioneer road which could subsequently be widened. The right of way was heavily timbered, and the preliminary step consisted of clearing it. Some of the trees, such as spruce and balsam, were desirable as sources of lumber, and these were cut into logs and disposed along the line for recovery later. Other growth was burned. So cleared, the path was ready for drilling.

The selection of equipment for this purpose was an important consideration. "Jackhamers" were suitable for the job from the standpoint of lightness and portability. However, it was desirable to drill holes as speedily as possible and of a size sufficient to permit the most effective use of explosives. The ground to be gone over ranged from hard quartzite, slate, and schist cliffs to a mixture of earth and bowlders. In some places solid rock was overlain by several feet of overburden. It was necessary to drill to depths of as much as 20 feet through these various materials. Heavy drills, which would strike powerful blows and which were equipped with rotative mechanisms that would prove dependable under the differing and difficult conditions, would naturally prove faster and more economical than hand-held drills. Wagon drills were known to be capable of meeting the requirements; but the extreme unevenness of the surface and the steepness of the slopes constituted a real problem when it came to moving them and setting them up. How the contractor sur-

PARKING SPACE FOR 500 CARS

At Newfound Gap, from which the "Skyline Drive" takes off for Clingman's Dome, a level area is being provided to accommodate 500 automobiles. This is being done by cutting deep into a mountainside (above) and by using the material to fill in the ground. At the left is the masonry wall that was built to retain this fill, for which 45,000 cubic yards was required. The wall contains 4,000 cubic yards of masonry and extends 25 feet into the ground below the base shown here.

PROTECTING A TREE

Rigid specifications govern this road job, among them the provision that trees must not be hurt by blasting. This picture shows how the contractor protects them. It is also stipulated that the road scar must not extend more than 70 feet vertically. To prevent fills from sliding down mountainsides, retaining walls such as that at the right are built on the down-hill side of the right of way in steeply sloping sections.

mounted this difficulty by the use of staging is shown in an accompanying illustration.

Timber horses of conventional type but with legs on only one end are used to form a base for planks along which the drills are moved as desired. The end without legs rests directly upon the ground, and either by digging out resting places for the two legs or by building up rock supports for them it is easily possible to accommodate the horses to any degree of slope. This leveling process is facilitated, especially on stretches consisting largely or entirely of rock, by the use of horses having legs of varying lengths. Because of the employment of platforms made up in this manner the drills can be shifted as rapidly and as readily as though they were on hard, level ground.

Two Ingersoll-Rand Type X-71 wagon drills are being used. Each is averaging 55 feet of hole per hour under the varying drilling conditions, and as much as 640 feet of hole has been drilled with one unit in an 8-hour day. Hollow, round drill steel of 1¼-inch section and with forged Carr bits having side holes is employed. Aside from the efficiency of the drills, themselves, the success that is being attained rests upon the fact that the staging is maintained well in advance of drilling in order that there will be no time lost in moving from one position to another. Including the operator, helper, steel carriers, and platform riggers, eight men are assigned to each drill.

Compressed air for these drills is supplied by two Ingersoll-Rand portable compressors. One of these, of 370 cfm. piston displacement, is an oil-engine-driven, 2-stage, air-cooled unit: the other is a 360-cfm., gasoline-engine-driven, 2-stage machine. A Lorain 75B shovel follows the wagon drills, loading the broken material into two Linn 8-cubic-yard tractors.

Along the line at various points behind these preliminary operations are in progress other essential activities. Retaining walls are being built where needed after the narrow pioneer road has gone through. All the rock for this purpose is obtained from the right of way. Each wall-building crew uses stiff-leg timber derricks for handling large stones, and it also has a small concrete mixer to supply mortar.

At Newfound Gap, the drilling that is required to provide material for filling in the parking space is done by "Jackhamers." The broken rock is loaded by a Marion Type 480 steam shovel into two Euclid wagons, each of which is drawn by a 50 Caterpillar tractor. These are fitted with bulldozers and serve to level the fill in addition to performing their regular duty of hauling. The outside edge of this parking area is held in place by a rubble-masonry retaining wall which contains 4,000 cubic yards of rock. The excavation in which it rests is carried 25 feet below ground surface.

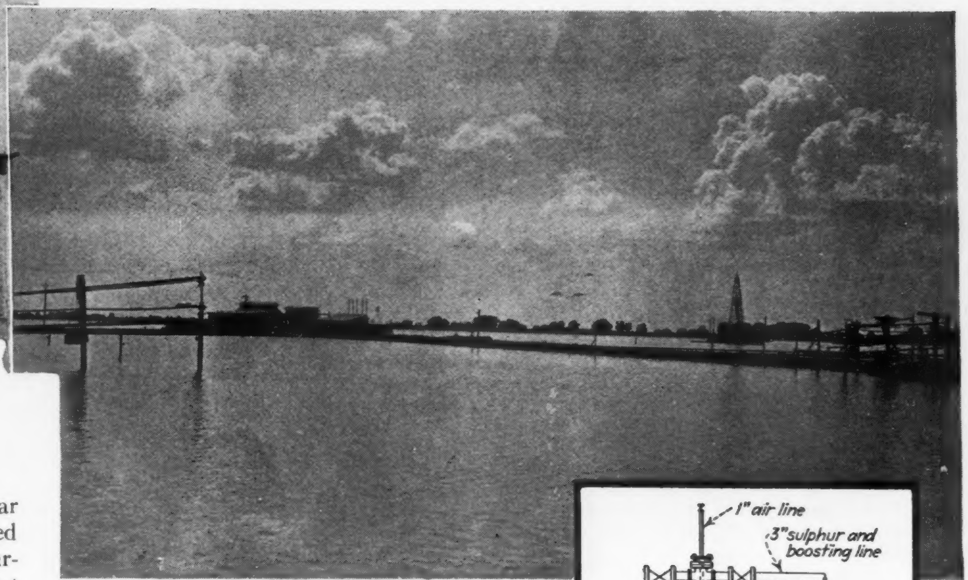
For the latter purposes mentioned, as well as for other work involved, there are employed ten Type S-68 "Jackhamers," four other small drills, and one N-75 drifter drill which is either fitted with handles or mounted on a tripod. These tools are operated with air supplied by three Ingersoll-Rand portable compressors, each having a piston displacement of 310 cfm. A fourth machine, a 2-stage, oil-engine-driven compressor, has a capacity of 250 cfm. A No. 40 sharpener and a No. 26 oil furnace recondition drill steels.

Work is carried on seven days a week. All labor is drawn from Sevier County, Tennessee, and Swain County, North Carolina, in both of which lie parts of the road. Employment is limited to eight hours a day and 40 hours a week. The contractor maintains a well-equipped camp at Indian Gap, about a mile from Newfound Gap. W. H. Anderson, a well-known southern contractor, is serving as superintendent for The Arundel Corporation; S. F. Ferguson is engineer; and C. L. Rohde is local agent for the contractor.

TWO SOURCES OF AIR

Six portable air compressors are employed on the job. These two are at the head of the road, supplying power for wagon drills. The machine in the foreground is an oil-engine-driven, 2-stage, air-cooled unit. Working a mile above sea level, it has been proved that this type exceeds conventional portables in point of economy.

Mining Sulphur Underneath a Lake



ALLEN S. PARK

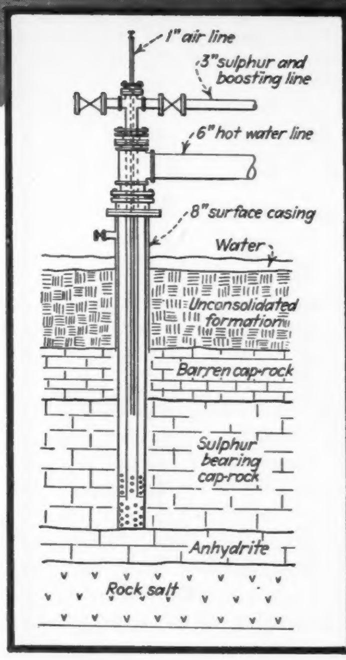
THE element sulphur, whose peculiar properties both awed and intrigued ancient peoples, serves many useful purposes in the arts and industries. It was first produced commercially in the volcanic regions of Sicily, where the natives gave it the name of brimstone—literally, "burning stone." The wasteful methods of recovering it that were practiced there tend, by contrast, to emphasize the high efficiency of modern procedure. The Sicilians filled pits in the ground with sulphur-bearing rocks and ignited the mass—the resulting heat melting out the sulphur. However, only one-third of it collected at the bottom of the pit, the other two-thirds were consumed by the flames. Today, sulphur is still recovered by melting it from its rock matrix, but none of it is destroyed in the process.

With the passing centuries, the scene of sulphur mining has shifted from the volcanic shores of southern Italy to the marsh flats of Louisiana and Texas. Approximately nine-tenths of the world supply now comes from these two states. More than 40 years ago Herman Frasch demonstrated at Sulphur, La., that it was unnecessary to dig for sulphur, which lay mixed with other earthy materials hundreds of feet beneath the surface. He merely drilled a well, forced quantities of hot water into it to melt the sulphur, and then pumped the fluid mineral out of the ground by means of compressed air. Save for improvements and refinements which the intervening years have brought, the practice remains substantially the same as it was in the beginning, and is universally known as the Frasch process.

The sulphur that comes from Louisiana and Texas may properly be considered a by-product of the petroleum industry. It was through the drilling of prospective oil wells that these sulphur deposits were discovered. In virtually all cases the sulphur is associated with salt domes which, as has long been known, set up conditions that are favorable to the occurrence of oil. Geologists attribute the formation of these salt domes to the effects of rock pressures. As they explain it, the weight of overlying sediments rendered deep-seated salt beds plastic, in which condition some of the mass followed fractures in the earth's crust to higher levels where, under a lessened pressure, it mushroomed out along bedding planes and formed an immense knob-like intrusion which correspondingly arched the overlying sediments. The anticlinal structure of the strata flanking such a salt dome is in what might be termed a made-to-order condition for the accumulation of petroleum. As a result, salt domes have been sought with great diligence by oil companies.

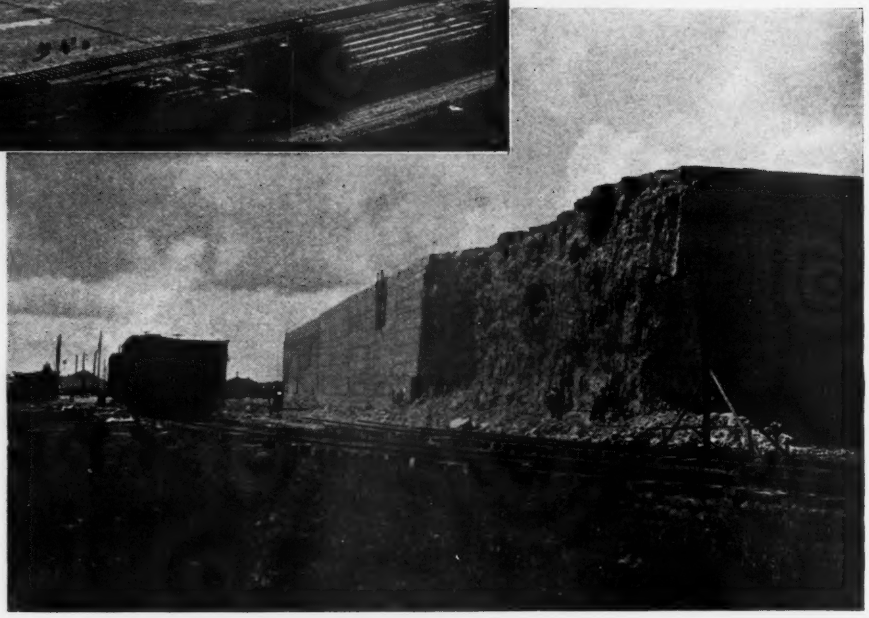
Many of the domes have yielded oil in paying quantities. In other cases the drills have failed to disclose commercial oil deposits, but the salt cores have proved to be pure enough to warrant working them for this familiar and important product. In still other instances the strata overlying the salt domes have been found to contain sulphur. Where indications pointed to deposits of sufficient richness and extent to permit profitable recovery, plants designed to use the Frasch process have been set up. Thus far, eight such domes have been brought into successful sulphur production in those states.

Of particular interest among these undertakings is the one at Barba, La., where the Jefferson Lake Oil Company, Inc., is obtaining sulphur from beneath the bed of Lake Peigneur. This concern, as its name implies, was organized primarily to produce petroleum. But because it discovered sulphur-bearing sediments under Lake Peigneur instead of oil, it has, in the short



LAKE SCENES

Above is a general view of the lake with the power-house stacks in the background. Extending across the picture is the trestle which carries the hot-water, compressed-air, and sulphur lines to the well sites. To obviate the driving of piling when drilling wells, the special barge shown at the upper left was developed. It can be moved quickly, and its use effects an estimated saving per well of $5,000. Because of its greater weight, the sulphur, which is melted by circulating hot water through the rock formation, flows to the bottom of the well. It is brought to the surface with compressed air through a piping hook-up, as is illustrated here.



SULPHUR IN BULK

The molten sulphur is pumped ashore to enormous vats, where it solidifies. When a vat is filled its retaining board walls are dismantled, leaving a huge mass of practically pure sulphur. As it is required to fill orders, the sulphur is drilled and blasted and loaded into cars with locomotive cranes.

space of three years, become an important factor in the world production of sulphur. The story of how this came about is interesting.

Adjacent to Lake Peigneur is Jefferson Island, one of five insular projections above the general level of the marsh which constitutes a part of Iberia Parish. It having been determined that Jefferson Island owed its existence to a bulging underlying salt dome, the Jefferson Lake Oil Company leased the land from the State of Louisiana and prospected it for oil by drilling a number of holes around the edge of the dome. All of them were dry. As a last resort it was decided to drill a test well in Lake Peigneur. At the time there was no reason to believe that structural conditions were favorable to the occurrence of oil, although it has since been determined that there is a salt dome beneath this area. It is probable that in days gone an elevation existed there and that circulating ground water, carrying away some of the salt in solution, caused it to subside until the present lake bed was eventually formed.

The initial well drilled in the lake area disclosed limestone cap rock at a depth of 650 feet. Ten feet below it were found traces of sulphur, and these increased as greater depth was attained. All told, the sulphur-bearing horizon proved to be 208 feet thick. Immediately beneath it was a bed of anhydrite, or calcium sulphate, and this was underlain, at a depth of 871 feet, by pure rock salt. Although little oil was revealed, the purity of the sulphur and the great thickness of the formation which contained it indicated that a find of considerable value had been made. After the existence of the deposit had been proved by drilling additional wells throughout the lake area, it was decided to mine the sulphur commercially, and plans were accordingly made to construct the necessary plant. This was in May, 1931. Production was started on October 20, 1932, and since then it has been as high as 1,400 tons a day. The total production to date amounts to approximately 500,000 tons. When operations were started, the venture was considered highly speculative—in fact, in some quarters the chance of success was deemed small. Today, by contrast, the company has an established place among the foremost sulphur producers of the world, and is shipping its product to all parts of the United States and virtually to all the leading foreign nations.

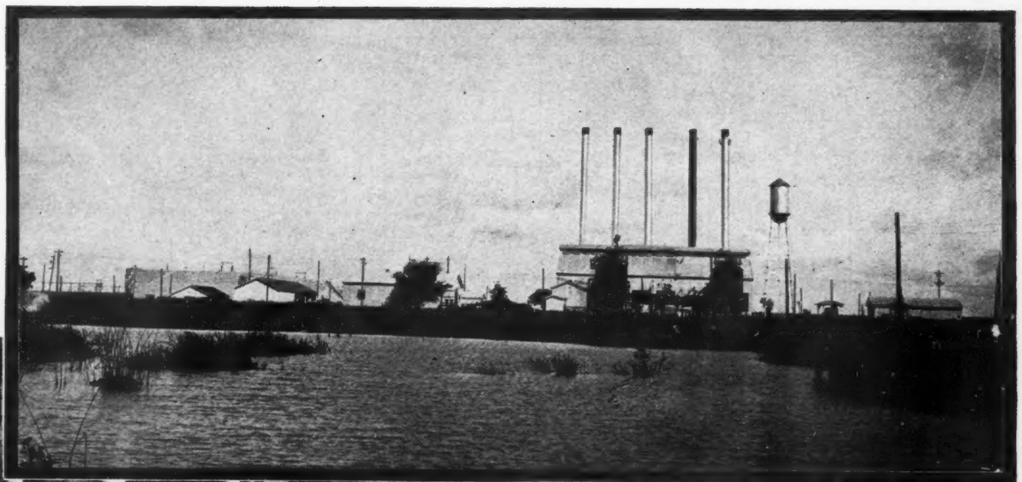
The formation in which the sulphur is found contains limestone mixed with calcite. The form and distribution of the sulphur are irregular. It occurs variously in thin layers; in crystals ranging from microscopic size to large columnar masses projecting upward through the beds; and in stalactites in the caverns hollowed out by circulating ground waters. As previously noted, the sulphur-bearing zone rests immediately on top of a band of calcium sulphate. The most reasonable explanation for the origin of the sulphur is that this calcium sulphate at one time extended upward into all or a part of the present sulphur-bearing horizon, and that it was altered into sulphur and calcium carbonate by the action of methane gas. Such a reaction would first form calcium carbonate, hydrogen sulphide, and water, and then the hydrogen sulphide in combination with oxygen would form water and sulphur. Stated in chemical formulas, these reactions appear as follows:

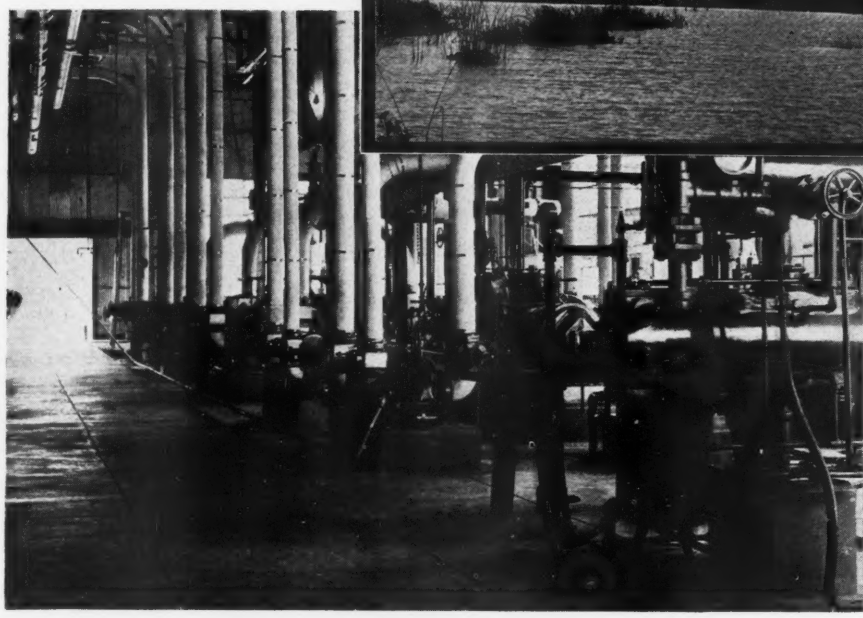
$$CaSO_4 + CH_4 = CaCO_3 + H_2S + H_2O$$

$$H_2S + \tfrac{1}{2}O_2 = H_2O + S$$

There is ample evidence to support the theory that the sulphur originated in the manner described. Large quantities of methane and of hydrogen sulphide are found in the sulphur horizon, and great volumes of hot sulphide waters circulate there. Moreover, wherever the calcium sulphate decreases in amount there is an increase in calcium carbonate and sulphur.

Physical conditions were unfavorable to the development of efficient and economical recovery methods. Lake Peigneur is approximately two miles long by one mile wide, and as virtually all the sulphur-bearing ground lies underneath it, drilling, of necessity, had to be done under difficulties. Also, since vast quantities of hot water had to be available at each well, provisions had to be made for supplying it to a large





POWER HOUSE AND EQUIPMENT
The power house, on the shore of Lake Peigneur, which supplies hot water and compressed air to the sulphur-mining areas that are sometimes a mile and more distant. At the left is an interior of the power house showing one of the three 3-stage air compressors and some of the Cameron pumps that handle the water.

number of locations scattered about the lake's surface. After a study of the situation it was determined that the most feasible plan was to build the power plant on the shore and to run the water, compressed air, and sulphur lines out over the lake on a timber trestle. This course proved to be a wise one, for it has made possible certain economies in connection with the construction and operation of the power plant; and no difficulties of great consequence have been encountered in maintaining the piping services even though some parts of the mining area are a mile or more from the power house. The latter occupies relatively high ground, a condition that made it unnecessary to drive piles to support the foundation. The site also had other advantages—it offered the shortest route for a connecting railroad spur with the Southern Pacific for the delivery of construction materials, and gave immediate access over a graded highway to the towns of Delcambre and Erath where workmen could find suitable living quarters.

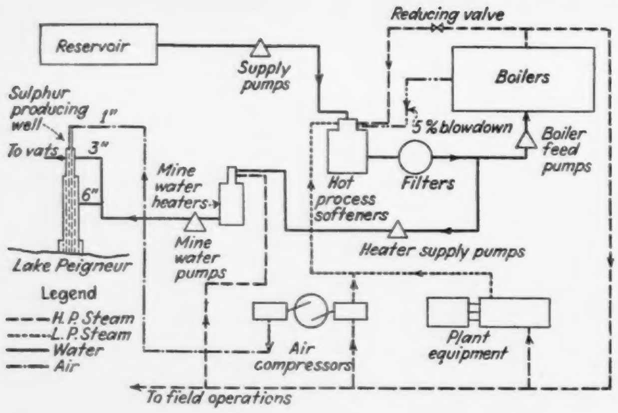
To provide a supply of raw water, two shallow 8-inch wells were drilled. One of these is pumped by air lift and the other by a motor-driven turbine-type unit. This arrangement of dual equipment is common to the entire plant and insures continuous operation—a factor that is of paramount importance, inasmuch as a shutdown of more than a few hours would cause enormous loss through freezing of the sulphur in the pipe lines and wells. Further, to insure an unbroken supply of water, a 50,000,000-gallon reservoir was constructed on a 20-acre site adjacent to the power plant. The water is delivered directly from the wells to this basin, from which it is pumped to the power plant by two Cameron centrifugal pumps each rated at 600 gpm. against 100 feet of head. In common with all the other water-handling pumps they are driven by General Electric steam turbines.

The power plant was designed to heat approximately 1,500,000 gallons of water every 24 hours to a temperature of about 320°F. and to deliver it to the wells at a pressure exceeding 100 pounds so as to maintain this temperature. In order to free the water of all scale and other substances, which might eventually plug the pipe lines to the wells, it is treated to insure zero hardness. This is done in a Cochrane hot-process-type unit which has a capacity of 40,000 gph. Lime and soda ash effect the softening by converting soluble bicarbonates into insoluble carbonates which are removed by passing the water through six nonsilicate filters. All exhaust steam from the turbines which drive the pumps, together with a continuous blow-down of 5 per cent of the boiler steam, goes to this treatment unit and serves to preheat the water to about 218°F. while it is undergoing softening.

Some of the softened water is delivered to the boilers by a Cameron pump having a capacity of 200 gpm. against 345 feet of head. The remainder and greater part is pumped to a Cochrane jet-type "mine-water" heater designed to work under 100 pounds pressure. This pumping is done by a Cameron unit rated at 510 gpm. at 300 feet of head. In the heaters the temperature of the water is raised from 218 to 320°F. This is accomplished with live steam which is generated by five Babcock & Wilcox Class H boilers of 600-hp. capacity that are designed for continuous operation at 200 per cent rating. The firing is now done with gas; but the system was laid out so that gas and oil could be used should that become necessary.

The heated water is pumped approximately a mile out from the lake shore for introduction into the wells. It is handled by a Cameron unit having a capacity of 510 gpm. at a 380-foot head which serves to increase the pressure to about 250 pounds. As previously stated, a trestle extends from the power plant out over the lake. This is supported upon creosoted piling and carries five pipe lines for hot water, steam, cold water, compressed air, and sulphur, respectively. A 3-inch layer of mineral wool covered by galvanized iron serves to insulate the hot-water, steam, and sulphur pipes.

At the sulphur station, where these lines terminate, booster pumps are provided for forcing the hot water into the wells. It



FLOW CHART

The procedure whereby hot water and compressed air are made to produce the sulphur underlying Lake Peigneur.

is essential not only that this water be put under a pressure sufficient to maintain it at a temperature higher than the melting point of the sulphur—240°F.—but also that the underground formation into which it is introduced be tight enough to maintain the required pressure.

Wells 10 inches in diameter are drilled to the cap rock immediately above the sulphur horizon. A string of 8-inch casing is then set on this cap rock, cemented in place, and the well completed. The equipment installed in each well for production consists of three pipes of varying sizes arranged concentrically within the casing. The largest of these is 6 inches in diameter and inside of it are a 3-inch and a 1-inch line. Stuffing boxes are provided at the surface to take care of the expansion of each pipe within the one of next larger size. The 6-inch line reaches to a point near the bottom of the sulphur zone. Its lower end is perforated by two sets of holes, one set above the other, having between them a diaphragm which supports the 3-inch pipe and seals off the overlying section of 6-inch pipe. The 1-inch pipe is hung from a coupling on the stuffing box at the top of the well.

The method of operating a sulphur well is as follows: The hot water flows down through the annular space between the 3-inch and the 6-inch lines and out into the sulphur-bearing beds through the higher of the two groups of perforations in the 6-inch pipe. Having a specific gravity of 0.9, it rises to the top of the dome, melting the sulphur contained in the rock formation through which it passes. The sulphur, being about twice as heavy as water, flows to the bottom of the well where the difference in pressure causes it to enter the 6-inch pipe through the lowermost set of perforations and to rise a short distance in the 3-inch pipe. Compressed air, which is forced down the well through the 1-inch pipe, is diffused through the liquid sulphur and serves, by the well-known principle of the air lift, to aerate it and to raise it to the surface. The air is supplied at the power plant by Ingersoll-Rand steam-driven 3-stage compressors which discharge at a pressure of 500 pounds.

Sometimes the sulphur is melted fast enough to permit a well to produce continuously for weeks or even months at a time. But when it happens that the melting lags behind the rate of air-lift pumping, the level of the hot water surrounding the piping is lowered to the point where some of it enters the perforations in the 6-inch line and rises inside the 3-inch line. When this water reaches the surface, and the pressure under which it has been held is released, it immediately flashes into steam, and the well is said to "blow." The air supply is then temporarily cut off and hot water is pumped down both the 3- and 6-inch lines until enough sulphur has melted to enable normal operations to be resumed. This is ordinarily accomplished in about three hours. Depending upon the character of the deposit in the area being worked, from 10 to 50 tons of water is required for each ton of sulphur recovered.

When it emerges from the well, the sulphur is delivered to an accumulation sump which has a capacity of 40 tons and which is steam jacketed to keep the sulphur in a molten condition. From this reservoir it is pumped by steam-jacketed Layne & Bowler special sulphur-handling pumps to the shore, where it is deposited in a large vat. There it solidifies into a huge mass measuring 160x500 feet in area and 40 feet high and having board walls. Once the mass has formed, the walls of the vat are removed and the sulphur is blasted down as required and loaded into cars by means of a locomotive crane. It is 99.92 per cent pure and, accordingly, needs no refining for ordinary commercial use.

The wells, being in every way simi-- to oil wells, are drilled with the conventional rotary type of oil-well rig. A special barge has been developed which makes it feasible to move the drilling equipment from one location to another in as little as ten minutes. Its use eliminates the driving of piling at well sites; and it is estimated that it effects a saving in drilling costs ranging as high as $5,000 a well. The barge is constructed of steel, and is fitted at each corner with an 8-inch pipe. When lowered to the lake bottom, these serve to hold it stationary in much the same manner in which spuds hold dredges. Careful distribution of the machinery makes it possible to keep the barge on an even keel. As the level of the lake varies as much as a foot during a 10-hour period, a telescopic joint has been developed to maintain connection with the casing of the well as the barge rises and falls. The drilling machinery is all driven by electricity, which is transmitted from the shore through a submarine cable. More than 135 wells have been drilled; and because of its success the rig has been duplicated by several companies that are engaged in drilling for oil under similar conditions.

In addition to the sulphur, the underlying rock salt contains other minerals that may be recovered later. On adjoining Jefferson Island, where the dome rises to within 95 feet of the surface, a shaft has been sunk, and the Jefferson Salt Mining Company is working the salt deposit at the rate of 8,000 carloads a year. Under the terms of the lease, the State of Louisiana is paid a royalty on all the minerals that are produced.

During its 40 years of development, the sulphur-mining industry on the Gulf Coast has met and surmounted numerous difficult problems, and of the achievements made in this direction, those of the Jefferson Lake Oil Company must be classed among the most interesting.

Acknowledgment is made to Lawrence O'Donnell, superintendent formerly in charge of the Barba plant, for the data on which the foregoing account is based and also to the Jefferson Lake Oil Company for permission to reproduce the illustrations which accompany it.

CROSS SECTION OF DOME

This sketch shows the relationship of the various formations. The sulphur deposit has an extreme thickness of more than 200 feet.

EVERY AIRPLANE A POST OFFICE
How air mail will arrive in our principal cities when they are linked by pneumatic tubes to their landing fields. Then carriers such as are shown here will be part of the equipment of every flying machine, and the postal matter on board will be sorted according to cities while in transit ready for dispatch the moment a plane alights. This picture is a recent one of a pneumatic-tube receiving station in New York's general post office.

Pneumatic Tubes to Speed Air Mail

WITH express trains and ocean liners equipped to assort postal matter *en route* to hasten it on its way, the next logical step in this direction is the flying post office. It is a recognized fact that valuable time saved in sending first-class mail by plane is frequently offset by delays in moving it from landing fields to local points of distribution. It is to remedy this state of affairs that Congressman Stephan A. Rudd, of Brooklyn, N. Y., has introduced a bill in Congress providing for faster air-mail delivery through the agency of pneumatic tubes. To demonstrate his point, a flying machine was fitted to handle postal matter, and railway mail clerks were assigned to sort it according to cities, placing the letters for each in a pneumatic-tube carrier or carriers holding 600 each. This is as far as the demonstration went; but, if the bill becomes law, air mail will be ready as soon as it arrives at a landing field to be dispatched to the general post office through connecting pneumatic tubes, and *vice versa*.

Whether or not New Yorkers believe in preparedness, the fact remains that 2,000 new carriers have been ordered for its pneumatic-tube system. These are to be put in service shortly, and will travel back and forth between the main post office at 33rd Street and its branches up and down town. The system now reaches from The Battery to 125th Street, with tubes measuring 54 miles; but, when the new Bronx post office at 149th Street is built in a year or so, it will be extended about a mile and a half and give that section of the city the service that its business activity warrants. The mail for this thriving borough, including that originating there, now goes to 42nd Street for distribution.

While previous articles published in COMPRESSED AIR MAGAZINE have dealt with the structural details of New York's pneumatic-tube system, it is not generally known that its robot mail carriers cover an aggregate distance of approximately 150,000 miles in making a daily average delivery of 6,000,000 letters. They travel at a speed of 30 miles an hour—44 feet a second—except upon approaching their receiving stations when they slow down quickly to one mile an hour.

The method of braking is what might be called a regenerative one, and is effected by means of compressed air which also serves to suck the carriers into the tubes at the sending points and to drive them to their destinations. When a carrier reaches the end of its journey, it passes through an air gate and immediately proceeds to check its own progress by compressing the air ahead of it against a second gate—by creating an air cushion that retards its forward movement within a short stretch to such an extent that it is brought to a safe halt in the post office. Most of the air required for braking is conserved, is returned to the main conveyor system by way of small ports before the second gate has opened to let the carrier through. A carrier weighs 30 pounds loaded, and is said to have a normal service life of 26,000 miles.

As can be appreciated, a large volume of air is needed in the operation of this network of tubes with its aggregate length of 285,120 feet. According to figures recently made public, the line, when not under pressure, contains 102,660 cubic feet of free air. But when it is subjected to a pressure of 5 pounds, the average maintained within the system when in service, the amount is increased to 137,578 cubic feet. To keep the carriers hustling back and forth in the distribution of first-class mail, about 28,000 cubic feet of air is fed into the tubes every minute, or 33,600,000 cubic feet throughout their 20-hour working day. This supply will, of course, have to be greatly augmented if the gap between the city and its air-mail landing field is to be bridged by pneumatic tubes.

RESTRAINING THE FATHER OF WATERS

Top—Bird's-eye view of Rock Island and vicinity showing the roller-gate dam in course of construction. The locks at the right have been in use since August, 1933. Center—Close-up of the locks with their gates shut. Both are 110 feet wide. The main lock (right) is 600 feet long and the auxiliary lock 360 feet. Bottom—The 1,266-foot service bridge that runs parallel with the upstream side of the dam.

Something Uni

ACROSS the broad reaches of the Mississippi River at Davenport, Iowa, there has been recently completed a dam of a kind that is comparatively new to this country. It is what is termed a roller-gate dam, and is the largest of five that have been and are being built in the United States. In Europe, where the type originated, many are in service, and the experience there has been that they are especially well suited for streams subject to violent fluctuations in flow attended with rapid sedimentation. Instead of being of rigid construction with a firm footing in underlying rock, the structure is movable for the most part—can be raised or lowered at will to check or to permit the free flow of water beneath it.

Rock Island Dam, or Dam No. 15 as it is designated, is part of a vast Government project to deepen the Mississippi between St. Louis and Minneapolis, a stretch of 645 miles—the purpose being to provide a navigable channel for boats of 9-foot draft. The dam consists essentially of eleven structural-steel cylinders mounted between concrete piers, and of two locks for the passage of shipping. Each cylinder is 109.25 feet long and, with the exception of the two end or skimmer gates which have a diameter of 16.16 feet, is 19.33 feet in diameter. The ends are sealed with plate-steel diaphragms that permit tail water to enter the cylinder so that it will not be buoyant when partly submerged; and they are provided with toothed rims that engage similarly toothed racks set in recesses in the contiguous piers. The track thus formed is inclined downstream at an angle of about 21° from the vertical, and on this the cylinder can be rolled up or down, as the case may be. Throughout the length of the cylinder is securely fastened a steel apron or lip that extends upstream and downward and is seated, when the gate is closed, on a sill approximately flush with the river bottom.

Each gate has its own hoisting machinery which is housed in a small concrete structure on top of one of the adjacent piers. It comprises a large sprocket carrying the multiple flat-link chain by which the cylinder is lifted and lowered, suitable reduction and self-locking gear, a 50-hp. induction motor with a magnetic brake, and remote-control starting equipment. Only one chain is required to handle the gate, and this is anchored to and partly wound around one end of its cylinder. The chain and the fixed track support the gate in any position, and heavy guard rails prevent undue longitudinal movement and disengaging of the toothed rims from the pier racks. Despite the fact that the cylinder is hoisted from one end only, the gate is kept practically level by reason of the close meshing and torsional strength. The slight torsional deformation that is set up as the cylinder rolls in its track is really of advantage in that it tends to loosen the grip of any ice that may have formed on the cylinder.

To assure the proper functioning of the dam during the winter months, when ice conditions in

g Unique in Dams

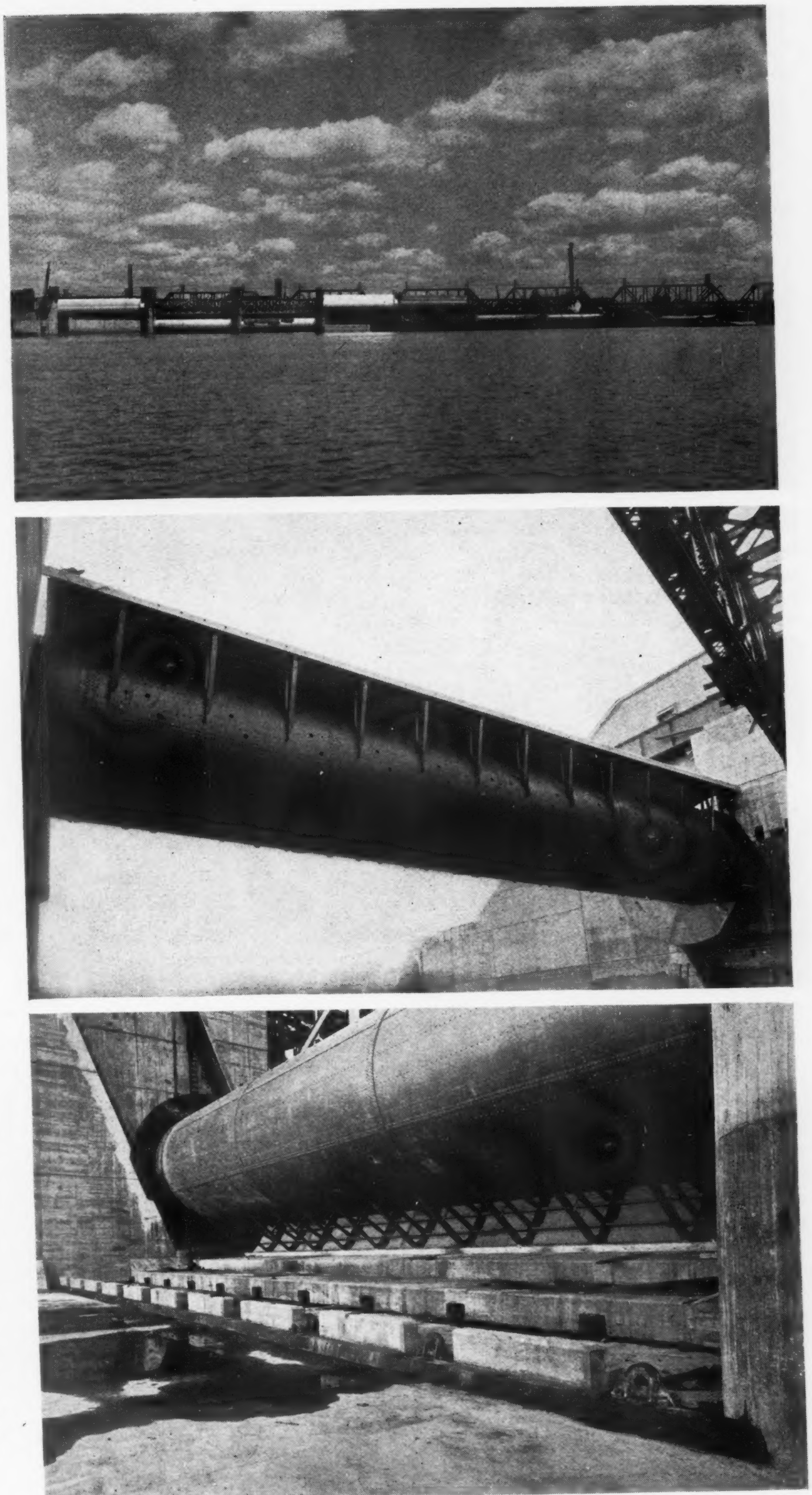
the Mississippi may be severe, the several gates are provided with a number of electric heaters. These are of the induction type, and are designed for use both above and below water. Some are installed in ducts back of the pier plates against which the cylinder diaphragms are pressed, while others are attached to the inner surfaces of those diaphragms. All are controlled from each gate's own hoist house.

Running parallel with the upstream side of the dam is a bridge of the deck-truss type that is equipped with two 30-ton electrically operated cranes mounted on separate levels. One of these serves the gates and appurtenances, and the other handles stop logs whose progress has been checked by the dam. The structure has a walkway, and connects the various piers with the Iowa shore and the river wall of the locks contiguous to Rock Island, or Arsenal Island as it is more generally known, which divides the stream at this point into two channels, both of which are now dammed.

Dam No. 15 is 1,277 feet long and extends diagonally across the north channel. Each cylinder is placed with its longitudinal axis at right angles to the stream flow and 33 feet below its neighbor on the south or Illinois side of the river. The crest of the nine main gates when closed is 26 feet above the sill while that of the skimmer gates, through which floating debris is removed, is 21.25 feet above. Each gate provides an unobstructed opening between piers of about 100 feet, and the combined spillway area is ample to take care of the flow under extreme flood conditions. In other words, the high-water stage attained at the site before the construction of the dam is in no danger of being exceeded.

It takes 50 minutes to open a gate. This may sound like a long period; but speed of operation is not essential, and the result is an appreciable saving in power. The superintendent stationed at the dam is always kept advised of up-river conditions, and this enables him to raise the gates in time to meet those conditions. Normally, they will remain closed: they will have to be opened but infrequently to permit the passage of rock, gravel, ice, etc., deposited in front of the protecting aprons. Accumulations of this kind are washed downstream with the first rush of water that surges beneath the gates as they are being lifted. A rotation of 150° is sufficient to bring a cylinder up to its full height, at which point it is safely above the river's maximum flood stage.

The immediate effect of Rock Island Dam has been the disappearance of the rapids in the 14-mile stretch between Davenport and Le Claire, Iowa, that previously were a serious menace to shipping. The pool thus formed has a navigable channel for vessels of 9-foot draft, and constitutes the first of a series of such pools to be created by the building of 23 more dams at different points in the Mississippi between St. Louis and Minneapolis. The total cost of this entire Government project of canalization is estimated at $124,000,000.



Photos, The Electric Journal and U. S. Engineers Office.

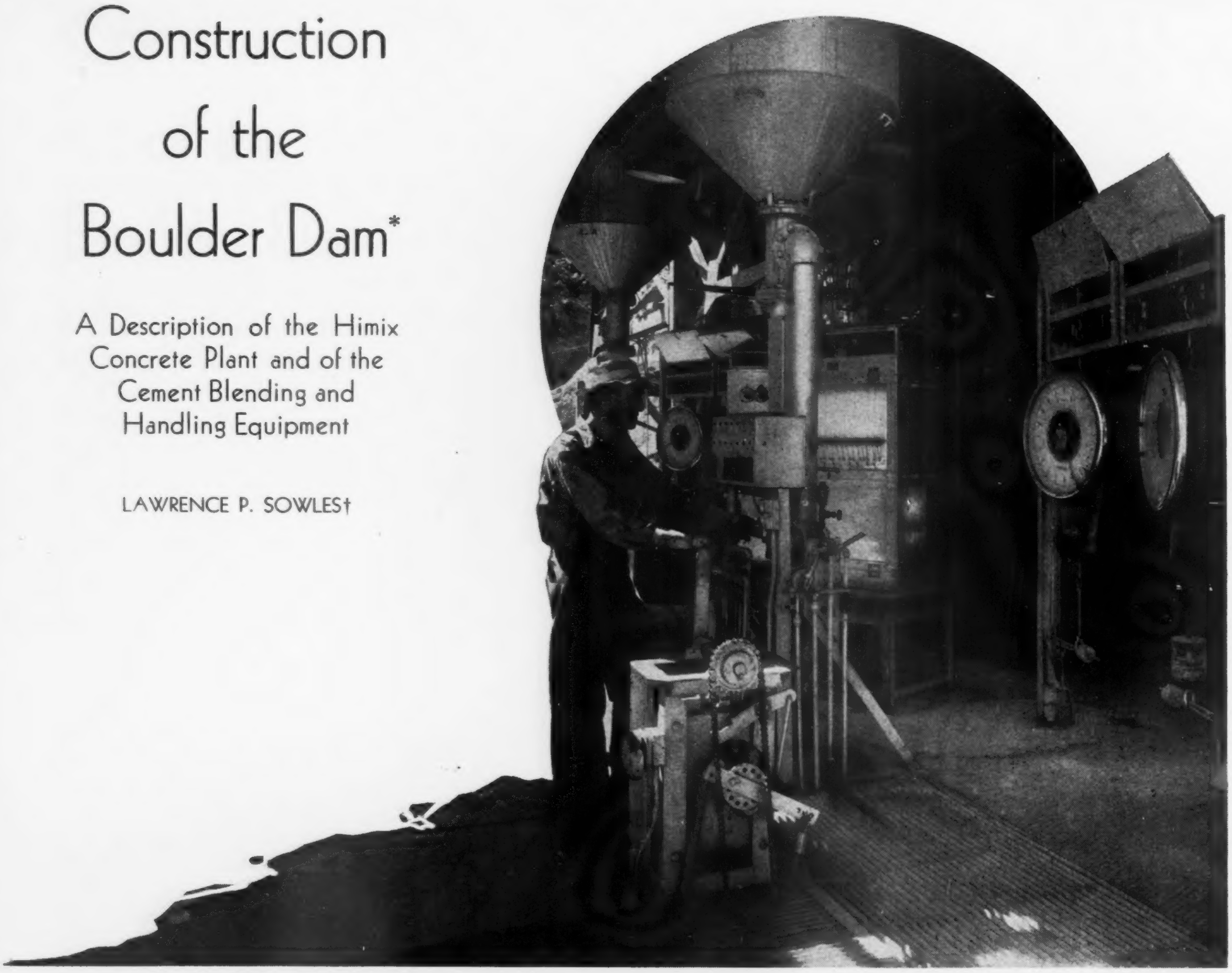
STRUCTURAL FEATURES OF THE DAM

Top—Rock Island Dam on July 15, 1933, when the work was well advanced. Center—Gate No. 1 from the upstream side showing the cylinder with its protecting apron in the raised position. Bottom—Gate closed and seen from the downstream side with the cylinder apron resting against the sill on the river bed. Note the inclined toothed rack in the pier wall (left) in which the cylinder travels.

Construction of the Boulder Dam*

A Description of the Himix Concrete Plant and of the Cement Blending and Handling Equipment

LAWRENCE P. SOWLES†



HIMIX CONTROL PLANT

The concrete mixing operations are controlled from this station. Just beyond the operator is the water batcher, and in front of him is the cement batcher. On the right are the batch meter and the timing device.

THE placing of concrete in the Boulder Dam is an operation of such magnitude that it is being followed with much interest by a great many people. But behind it there are other operations which, though of a preparatory nature, are equally worthy of attention. Trainloads of gravel washed and screened to five different sizes must be delivered to the mixing plants with such regularity that there is always ample material on hand. Cement arriving by trainloads from four different mills must be unloaded and blended before it can be used. Water must be taken from the river, settled, and clarified, and pumped again to storage tanks above the mixing plants where it becomes an important constituent of the concrete. The various materials have to be mixed at the two plants built for this purpose—at the Lomix plant, which has provided all the concrete for the dam below and up to elevation 720, as well as some poured between elevation 720 and approximately 950—and at the Himix plant, which is supplying the remainder required between elevation 720 and 950 and all the concrete from elevation 950 to the top.

The Himix plant, which is now the center of these activities, will serve well to illustrate the operations preceding the delivery of concrete at the dam and also the manifold ways in which power in the form of electrical energy and compressed air is directed and coördinated so as to produce millions of cubic yards of concrete with unprecedented speed. About 5,000,000 barrels of cement, equivalent to 20,000,000 sacks, will be used in the construction of the dam and appurtenant works, and must be handled at rates as high as 10,500 barrels—about 35 carloads—per day.

The high-level or Himix plant is located at elevation approximately 1,232 on the Nevada rim of the canyon that offered the only available open space of sufficient area near the dam site to accommodate it. The plant is adjacent to the roadway which will ultimately be carried across the top of Boulder Dam and at the river terminus of the U. S. Construction Railroad. Grouped around it are a number of subsidiary structures—the plant where the cement received from four mills is blended into a material of uniform color and properties; a transport system which delivers the blended cement into the Himix silos and, through more than a mile of piping, into the Lomix storage bins; a screening plant which provides the fine cement necessary for the proper grouting of the contraction joints in the dam; and the shops required for the maintenance of these several plants and of the railroad system that hauls the concrete from Himix to the dam.

The Himix plant has been designed not only to produce concrete that will meet the rigid Government specifications set for the Boulder Dam concrete but also to deliver it at rates that will meet the contractors' schedule. Mechanically it is similar to the Lomix plant, which has been described in the November, 1932, issue of COMPRESSED

†Engineering Department, Six Companies Inc.

*Eighteenth of a series of articles on the Colorado River and the building of the Boulder (formerly Hoover) Dam.

Air Magazine—the only material difference being in the arrangement and layout. In building the plant, the advantages offered by the topography have been turned to best account with the result that the concrete flows by gravity and in as nearly straight a line as possible. The aggregates are delivered by a railroad running out on a trestle built over bins so that they can be dumped directly into them from the cars. The bins are of timber construction retained on the sides by steel beams and tie members that are integral parts of the steel railroad trestle, and rest on a reinforced-concrete floor and columns. The batchers, which weigh out the various aggregates for the mix in the exact proportions determined by the Government engineers, are hung from the bottom of the concrete floor. One set of batchers supplies each mixer, and the several units are arranged in a line so that the materials drop on to a belt conveyor that delivers them to the hopper feeding their mixer.

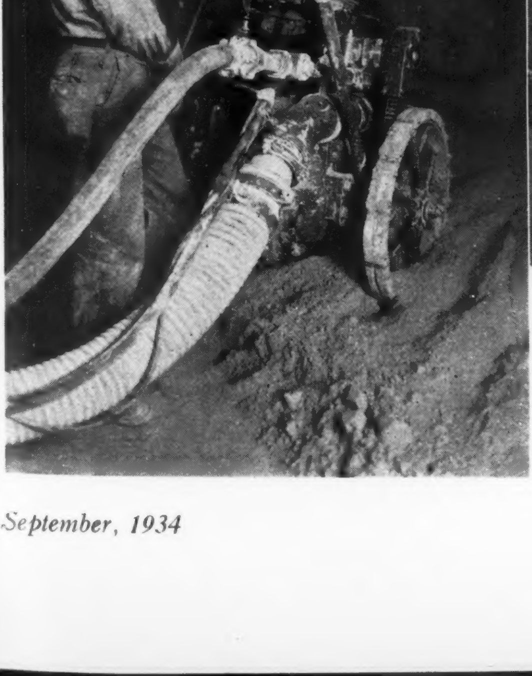
When busy at their assigned job, these automatic batchers are fascinating to watch. The entire operation is, of course, under the control of the man at the mixer, but the apparatus is so interlocked that it is necessary for him simply to push a button to release the right quantities of aggregates from the batchers in such a sequence that the fine material falls first on to the belt conveyor and provides a cushion for the coarser material that follows. This done, the discharge doors close automatically and latch, if they are free from obstructions. This latching sets in action a solenoid valve that controls the flow of compressed air to an air-operated gate through which aggregates are again admitted into the batchers from the bins above. As the material in a batcher approaches the predetermined weight, the gate partly closes and cuts down the flow: it does not close completely, however, until the precise amount has been measured out into the batcher. The noise accompanying this operation, which is induced by the rapid opening and closing of the compressed-air gate valve and the falling of the rocks into the eight batchers, is so ear-splitting that when it suddenly ceases, and everything becomes silent, one cannot help being impressed by the fact that the compressed-air and electrical-control devices have done very exacting work at the touch of a button by an operator remote from the batchers. These, as well as the Lomix batchers, were supplied by C. S. Johnson Company, Champaign, Ill.

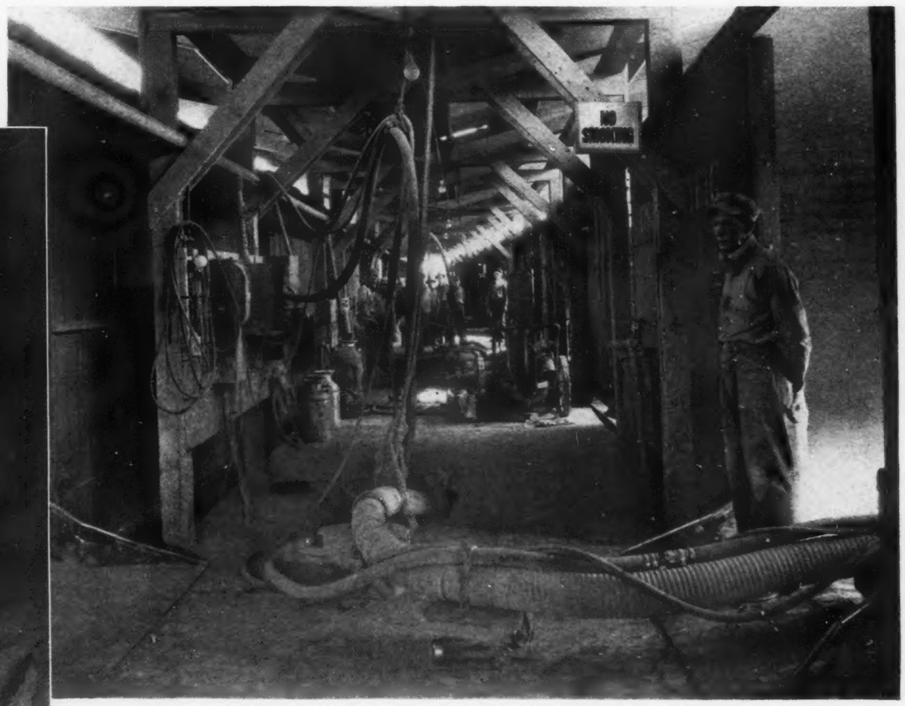
Four mixers are mounted upon a large block of reinforced concrete that also serves as a support for four cement silos, one above each mixer. These silos are steel cylinders, 23 feet in diameter by 48 feet high, having conical bottoms to which the cement batchers are directly connected. Each has a capacity of 5,000 barrels of cement, equivalent to 20,000 sacks.

Cement and water in the right proportions are weighed out automatically and discharged from weigh batchers into the several adjacent mixers by the operator. Behind him is a recorder and a control board. The recorder indicates the weight of each of the different materials in a batch and the hour it was fed to the mixer. When all have been delivered and mixed the specified length of time, a clock automatically signals to the operator that the batch in the mixer is ready to be turned out.

The mixers are of the 4-yard tilting type. The first two installed were Smith mixers. Later were added two Davis mixers which had been used originally for mixing concrete on the Owyhee Dam, and, finally, one Smith mixer was removed from Himix and placed between the bins and the mixer block to deliver concrete to No. 9 Cableway by means of an auxiliary track constructed behind the mixer block. Each mixer is so mounted that its whole frame tips, allowing the contents to be discharged cleanly in a few seconds. Below each is a 9-yard hopper with an air-controlled slide-gate outlet. Operating independently, a mixer can thus prepare two 4-yard batches of concrete and load them into its hopper ready to fill without delay one of the 8-yard concrete buckets when it reaches the mixing plant on its return from the dam. In this manner little time is required for loading at the plant. This has proved to be a decidedly important factor in maintaining the high concrete-production records so far made.

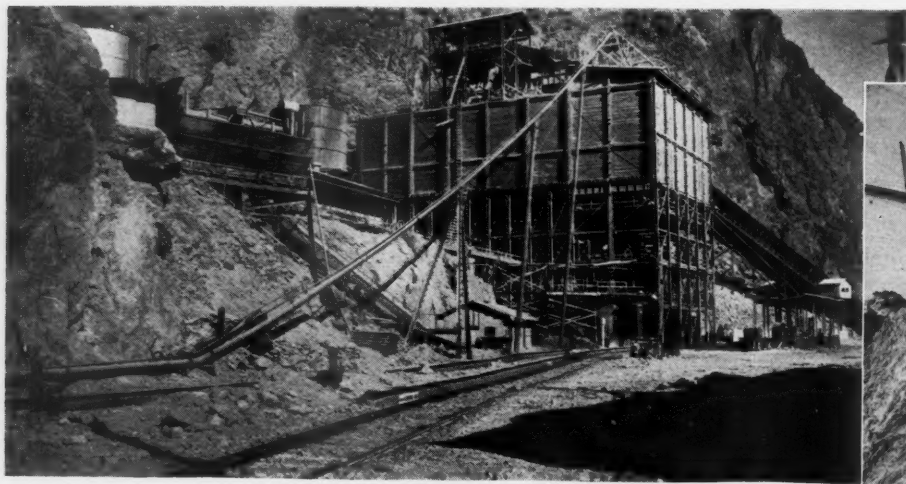
Cement is brought to the project in standard 40-foot box cars especially selected for the service and fitted with special floors and spouts in the roofs that permit filling the cars at the mills by gravity. The cars are run on to a siding adjacent to the

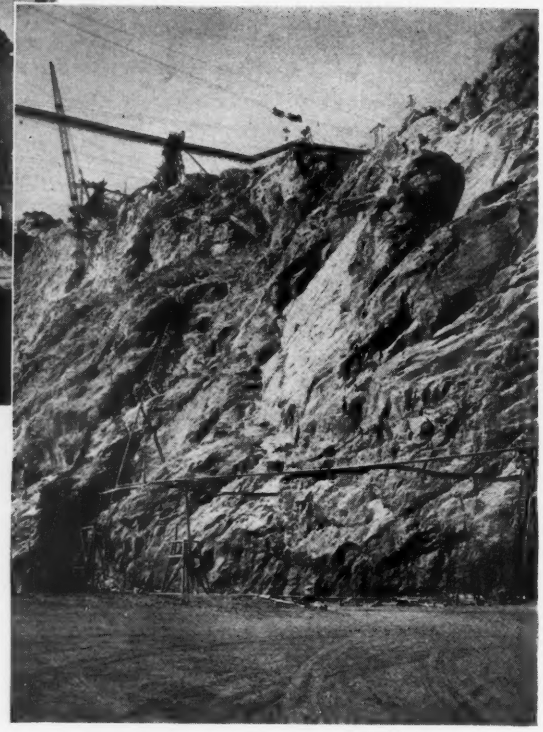




UNLOADING CEMENT PNEUMATICALLY

Box cars filled with cement come in on a siding above the Himix plant. Between the two tracks is a platform, which is shown above. By means of Fuller-Kinyon air-operated pumps the cement is transferred at the rate of 150 barrels an hour into blending silos. These pumps are mounted on wheels to facilitate moving them as required. At the left is one of these units in a car of cement.





CEMENT TRANSFER LINE

The 9-inch pipe line through which blended cement is delivered from the Himix to the Lomix plant traverses rough ground in reaching the canyon bottom (right). At the upper left in the picture is the 180-foot boom of the derrick that handles concrete for the Nevada intake tower. Above is the lower terminus of the cement line at the Lomix plant.

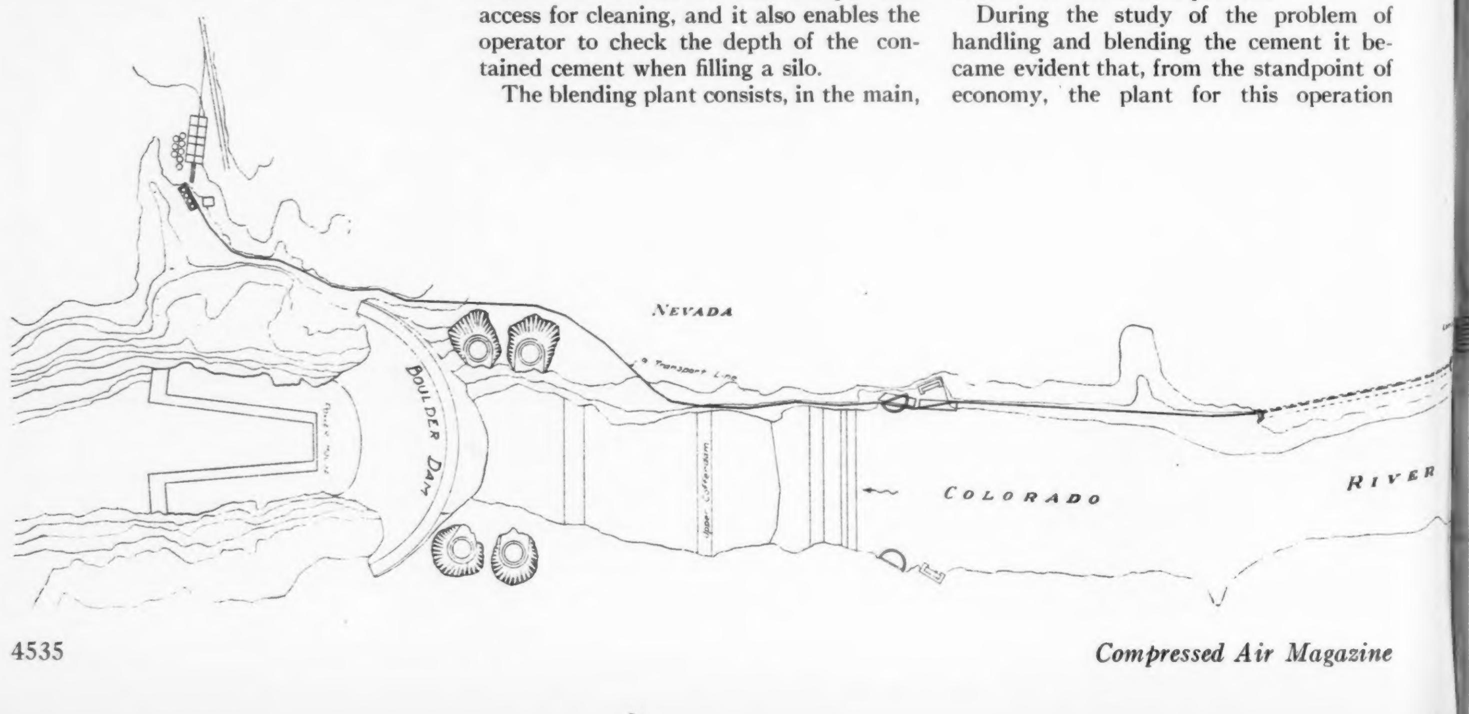
Himix plant where the bulk cement is unloaded by a Fuller-Kinyon pneumatic transport system. The cars have timber partitions so set that there is an open space between the two doors. This enables removing the bulkheads and starting the unloading machines without cement wastage.

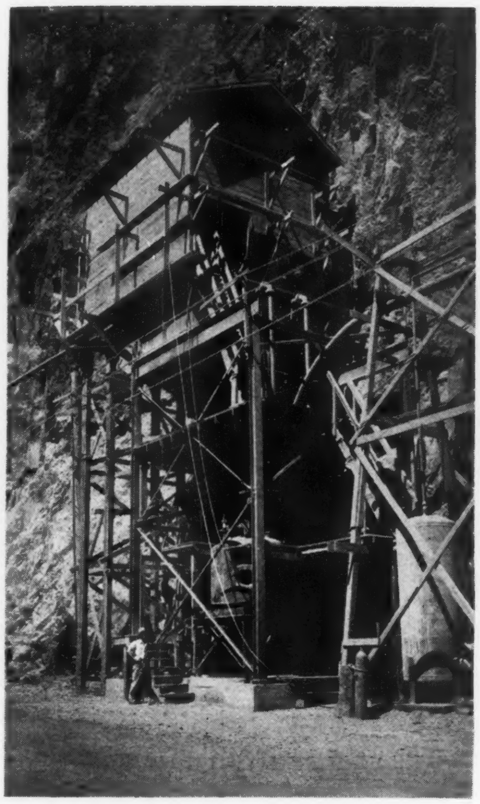
The siding provided for this purpose comprises two parallel tracks, approximately six cars in length, and a covered 13-foot timber platform between them. The unloading system consists essentially of Fuller-Kinyon cement pumps each of which is mounted on wheels in such a way that it can be directed by an operator into the pile before him. The cement discharged from a pump is conveyed through a 5-inch line to one of the silos at the blending plant. Three pumps handle the normal demand, with two pumps held in reserve as spares. One machine unloads a 300-barrel car in about two hours. Normal cement consumption necessitates the unloading of about 30 cars a day, working three shifts. The fundamental principle upon which this system operates is that cement—finely ground powder—when mixed with a sufficient amount of air, becomes a semifluid material and flows much like water or any other fluid. The compressed air provides the force that drives the cement through the conveyor and into the silo.

The 5-inch lines from the three cement unloaders are carried across to the blending plant and are manifolded so that any one pump can deliver into any one of the eight silos. When the cement arrives at the bins, the velocity of the mixture drops sufficiently to allow all but a minute amount of the cement to settle out of the air. Attached to each bin is a vent which, as the cement is deposited in the bin, permits exhausting the air that was introduced into the pump when fluffing the cement. A manhole in the roof of each bin provides access for cleaning, and it also enables the operator to check the depth of the contained cement when filling a silo.

The blending plant consists, in the main, of the cement unloading system, of the eight raw-cement silos, and of a set of variable-speed feeders. The latter control the discharge from the various silos into a long screw conveyor which mixes the cement as it carries it to the bin of the cement transport system. Each silo is 21½ feet in diameter and 48 feet high, and holds approximately 6,000 barrels of cement. The correct rate of feeding each brand of cement from the blending silos is determined by Government inspectors, and the result of their calculations is given to the operator of the plant who sets the variable-speed drive on each rotary feeder accordingly. The feeders have a range of from 50 to 200 barrels per hour.

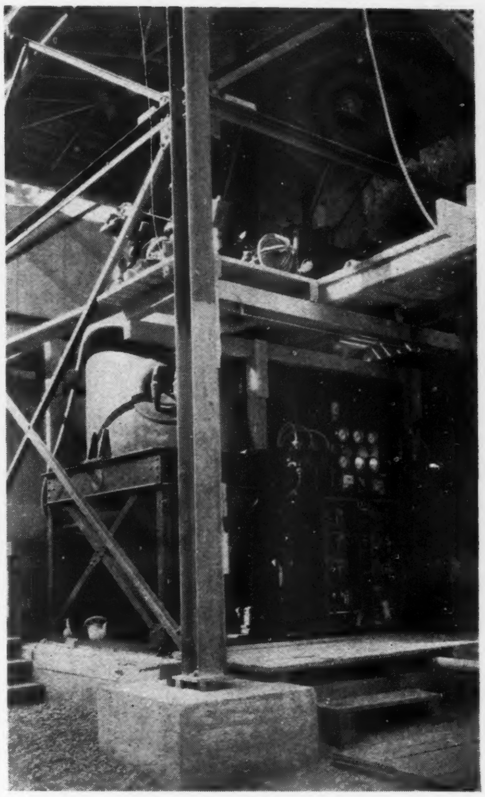
During the study of the problem of handling and blending the cement it became evident that, from the standpoint of economy, the plant for this operation





SECOND-STAGE FLUXO PUMP

As installed, the cement pumping system has a booster Fluxo pump in the canyon bottom at a point 2,460 feet from the primary pump. The view at the left shows the booster station with the housing designed to collect the cement from the air upon being discharged from the incoming pipe line. The direction of movement is towards the right. After the system had been operating for six months it was found that the pump at Himix would deliver cement at a slightly reduced rate to the Lomix plant. As a result this booster station is now used only intermittently. At the right is a close view of the No. 2 or booster Fluxo with its control box. The No. 1 unit at Himix is a duplicate of this one.



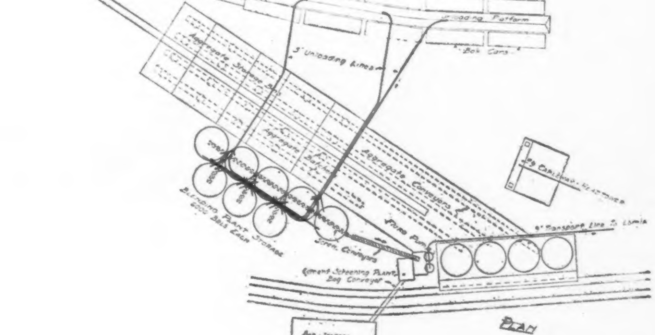
should be located adjacent to one of the two mixing plants. However, this meant transporting cement from there to the other plant. Upon investigation it was found that this could be done at a cost that would not be prohibitive by the use of a Fluxo pump system. By this system the cement from the Himix blending plant is delivered to the Lomix plant in either one or two stages through a 9-inch line. The first-stage pump is located at the Himix mixer block, and the second-stage pump is situated on top of the upper cofferdam on the Nevada side of the canyon.

In laying out the Fluxo system the 9-inch transport line had to be carried over the difficult topography along the high-level road, across several deep draws on cable spans, and down the side of the Nevada Canyon wall to the bin for the second-stage pump. From there it had to be run along the canyon wall, across the top of the double-track bridge on the concreting railroad at elevation 720, and then along the track and through No. 1 Railroad Tunnel to the Lomix plant. From the outlet of the tunnel to the Lomix plant the line is supported upon a cable span approximately 300 feet long and rising about 105 feet to the top of the cement bin. Interposed at this point in the line is a valve which permits emptying the cement into the bin at either one of two levels. The total pumping distance is 5,420 feet—the first stage being 2,460 feet long and the second 2,960. After a working period of approximately six months, it seemed practicable, by slightly cutting down the hourly capacity, to pump directly from the blending plant to the Lomix plant in a single stage. This cut-over was tried, and was very successful.

In the operation of the Fluxo pump, we have an unusual application of compressed air in the field of materials handling. Pumping is accomplished entirely by the energy exerted by the air, which serves also to fluff and to make the cement semifluid. The pump, itself, consists of two cone-shaped, bottom-pressure tanks 6 feet in diameter and 9 feet high. These are interconnected electrically and mechanically so that one is discharging while the other is filling. The various interlocks regulate the time of admission and cut-off of the compressed air to the tanks. The system is operated by means of a series of relays containing a number of Mercoid electrical switches which, in turn, actuate solenoid valves that control the air supply to and from the tanks. The pumps were manufactured by the F. L. Smidth Company, of New York City, and installed by Six

CEMENT TRANSPORT SYSTEM

At the left is the route of the 9-inch pipe line through which cement is transferred from the Himix to the Lomix plant by means of a Fluxo air-operated pumping system. During the course of its movement, the cement travels 5,420 feet and drops more than 500 feet. This installation makes it possible to blend all the cement at the upper plant and eliminates a circuitous rail haul of some fifteen miles into the canyon. The layout of the Himix plant is shown at the right. During the course of the work, 20,000,000 sacks of cement will be blended there.

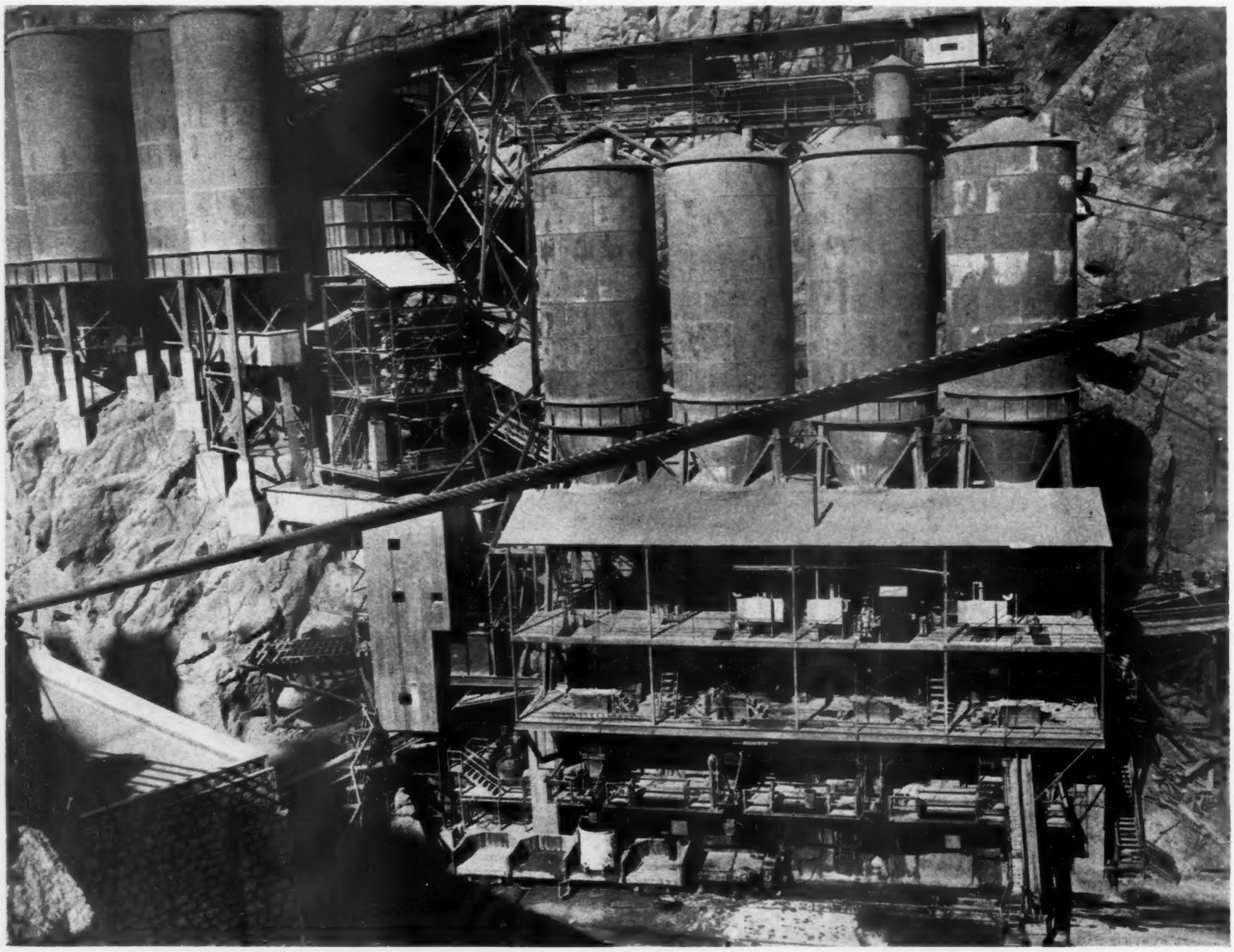


Companies Inc. under the direction of Smidth Company engineers. Each transports 450 barrels of cement an hour. The first-stage Fluxo pump, in addition to delivering cement to the Lomix plant, also delivers it, through a 6-inch line, to any of the four silos at the Himix plant, or, through another 6-inch conveyor, to the bin of Himix "E" mixer. The line first referred to is manifolded on top of the silos so as to reach any one of them.

As a result of the tests made at the Denver office of the U. S. Bureau of Reclamation, it was found desirable to employ a very finely ground cement for the grout for the contraction joints in the dam because it would assure a more uniform filling of the joints, a more uniform thickness of grout in each joint, and a better penetration of the grout to every part of a joint. But instead of specifying the use of a finely ground cement that would pass the requirements, it was decided to take the blended cement that goes into the concrete for the dam and screen it, thus removing from it all material that will not pass a No. 200 screen.

Six Companies Inc. have constructed a screening plant for this purpose next to the No. 1 Fluxo bin. Blended cement is drawn from the nearest Himix silo through a feeder into the primary screen— a 6x5-foot Tyler Hum-mer. The rejects from this are fed to another Tyler Hum-mer screen that measures 3x5 feet. The product which passes these screens goes into a bin from which it is sacked in paper bags to simplify handling the cement in its transfer to points of use. When a bag has been filled by the packer, it is delivered to a slat conveyor which carries it to a screened storage shed a short distance from the plant. This shed holds 2,000 sacks. The plant has a rated capacity of 2,600 pounds of cement per hour, and the present estimated requirement for contraction-joint grouting is 26,000 sacks. The Bureau of Reclamation has specified that screened cement for grouting shall not be stored longer than seven days after screening or before use. A plant of the aforementioned capacity is therefore needed in order that all the cement for any one grouting lift can be produced within the 7-day limit set.

The plants described were designed and laid out by the Engineering Department of Six Companies Inc. under the supervision of A. H. Ayers, chief engineer, and J. P. Yates, office engineer, and, with the exception of the patented equipment, were constructed by that company under the direction of F. T. Crowe, general superintendent, and Bernard Williams, assistant general superintendent. Ira Carpenter, concrete production foreman, is in charge of the operation and maintenance of the Lomix and Himix plants, as well as of the concrete-blending, transporting, and screening plants.



GENERAL VIEW OF THE HIMIX PLANT

This photograph shows the installation as it now stands. The four silos to the right each hold 20,000 sacks of cement. Below them is the mixing plant, containing four 4-cubic-yard units. One of them is shown filling an 8-cubic-yard bucket stationed on a car. The chute across the tracks at the lower right is for loading agitators. The silos at the upper left are for blending cement. Between them and the mixing plant proper may be seen a fifth concrete mixer which supplies cars on a track leading to No. 9 Cableway. At the top are cars on the cement unloading siding. The cables crossing the picture are backstays for the Government 150-ton cableway.

NEPTUNE'S NEW CONSORT

THE romance of the sea always has had a strong hold on the British people, and they will demonstrate its continuance on September 26, when 100,000 of them will throng the banks of the Clyde River to watch the launching of the gargantuan new Cunard-White Star liner. Preparations as elaborate and careful as for a coronation have been made for the event, and the occasion will be graced by the presence of royalty. Known thus far only as the *534*, the new boat will be christened by Queen Mary. No one outside a restricted circle knows what name has been selected, although *Victoria* is the leading speculative choice.

As she leaves the ways at the Clydebank Shipyard, the *534* will weigh 46,000 tons. When completely equipped for her trials, in the spring of 1936, her tonnage will have been increased to around 73,000. So huge will she be that it will be somewhat of a problem to dock her in the Hudson River at New York when she enters transatlantic service. Her size likewise has brought complications in connection with the launching. The Clyde is so narrow at the point where the vessel awaits her wedding with the water that it was feared tugs would be unable to slow her down enough to keep her from burying her stern in the mud of the opposite shore. Accordingly, drag chains have been attached to her hull to retard her speed down the ways. To eliminate the possibility of her plunging so deeply as to scrape her keel upon the bottom, the water in the vicinity has been deepened by dredging.

Only 4,000 persons can get inside the shipyard, so 96 per cent of the spectators will view the spectacle from outside. Within the yard a 5-room suite has been prepared for the King and Queen, who will mount to their quarters at the launching-platform level on a special elevator. The yard's molding loft has been transformed into a huge dining room, and 1,000 persons will be served luncheon there.

Americans will gain a vicarious thrill from all this, and will await with keen interest the day some two years hence when this new empress of the high seas will slip past the Statue of Liberty into New York Harbor.

CHECKING DAM FOUNDATIONS

UNQUESTIONABLY, the painstaking precautions that are being taken by engineers of the Tennessee Valley Authority to make sure that the dams they are building shall be placed upon firm foundations are worth the time, effort, and money they entail. Unless a dam is safe, it is a public liability, and unless it is leakproof, it is only partly useful and its value is disproportionate to the money expended for it.

Dam builders have always sought to make their structures secure and to seal watercourses in abutting and underlying formations. The distinctive contribution of the TVA has been to develop and use new and more positive methods of making certain that these objects will be accomplished. The idea of sampling the subsurface in dam areas is as old as modern hydraulic engineering, but never before has there been such a complete utilization of mechanical equipment for this purpose.

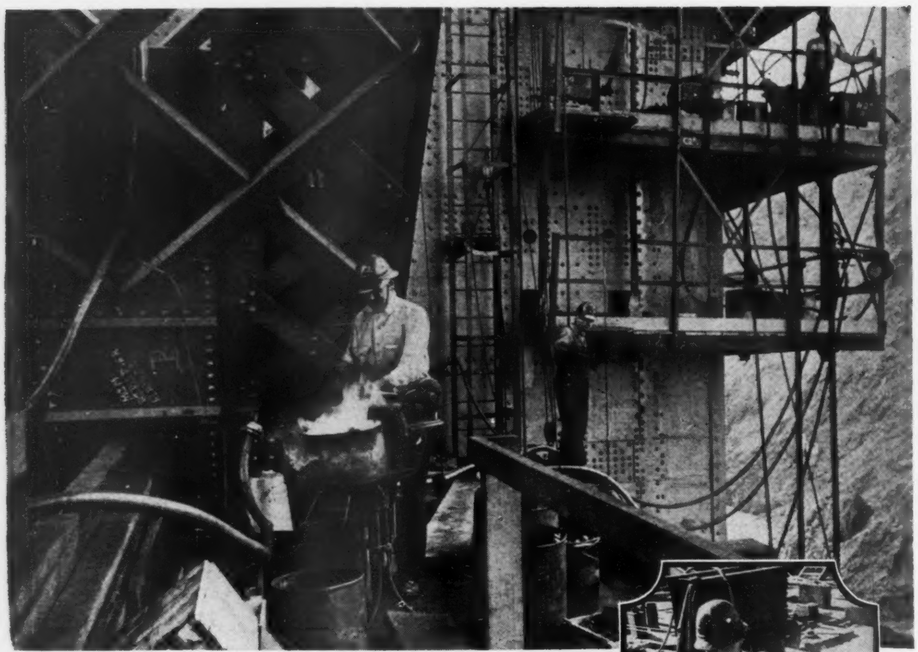
The facility and speed with which cored openings large enough to admit a man are made at Norris Dam were brought out by an article in our August issue. Cores, regardless of their diameters, are in themselves invaluable guides to engineers and geologists; but visual inspection of the actual foundation material in place removes the last vestige of doubt as to its stability. Since drills capable of making holes of sufficient size to permit such a check have been available for many years, it seems strange that full advantage of them has not been taken sooner. No doubt they will be standard equipment of dam builders in the future wherever underground conditions give the least hint of harboring hidden defects that might provoke trouble.

TRENDS IN TRANSPORTATION

OUT of the economic pinch of the past few years have come many repercussions, some of them entirely unexpected. For one thing, our ideas of transportation have undergone some rather broad revisions. Forced to fight for life-sustaining business as they never fought before, the railroads have come through gloriously with faster schedules, air-conditioned trains, and lower fares. For these things they will have the blessing of all those that must spend a fair share of their time going from place to place.

The two-cars-in-every-garage slogan has gone into the discard, at least temporarily, and thousands of families have discovered that the car they had thought ready for the scrap heap still has a good many thousand miles in its somewhat rattly frame. Coincidentally, many persons that had grown accustomed to the deep-cushioned luxury of large, expensive automobiles learned with pleasure that small, easier operating cars are quite endurable to the body and extremely kind to the pocketbook.

Strangest of all the transportation changes is the comeback of the bicycle. This plebeian vehicle, we are told, is now being manufactured in the United States at the rate of 300,000 a year, which is 30 per cent of the high mark attained around the turn of the century. With the country gradually regaining firm financial feet, no one is predicting a continued upswing in cycling, and there is small chance that wheeling clubs will return to popularity. Nevertheless, in some sections of the country the reversion to this 1900 mode of traveling has reached such proportions as to give rise to an additional traffic problem. Accidents in which cyclists figure are becoming alarmingly frequent, although they are still far below the rate in the British Isles, where the 1932 figures reveal 444 deaths and 19,071 injured. In our nation, bicycles are largely confined to urban districts where wide streets and relatively slow traffic afford some protection to riders.



PNEUMATIC RIVET PASSER

Up or down, around corners, or across spaces, this system delivers hot rivets direct to points of driving. These pictures show it in use on the Marin Tower of the Golden Gate Bridge 280 feet above the water surface.

Delivering Hot Rivets with Air

THE accompanying pictures illustrate equipment in use on the Golden Gate Bridge, San Francisco, for delivering hot rivets from forges to riveters by compressed air. Twelve of these units are in service there at the present time, and it is likely that others will be added as the erection of steel progresses.

Apparatus of this type was designed primarily for use in shipyards, and is especially helpful where rivets must be driven in the interiors of submarines and in other confined spaces where gases from forges would be objectionable and even dangerous. Each unit consists of a cone-shaped air reservoir on which is mounted a head for holding the rivet, a suitable length of connecting flexible steel tubing, and a receiving receptacle. The heated rivet is dropped into an opening in the head, where its weight opens a flap valve and allows it to drop through. The valve closes after it through the action of a counterweight. By stepping on a foot treadle, near the base of the reservoir, the operator releases a blast of compressed air that carries the rivet through the flexible tubing at a speed of about 15 feet a second. The receiver is a metal cylinder containing a spring element which cushions the impact of the arriving rivet. The rivet may be picked out of the receiver through a slot in the side, or the receiver can be placed so that the rivet will roll out on to a piece of sheet steel or other surface. Compressed air is obtained from the regular delivery lines to the riveters through ¾-inch hose connections.

On the Golden Gate Bridge the riveting gangs are generally working about 50 feet higher than the forge locations, although at times the gap between them amounts to as much as 100 feet. The pneumatic rivet passer is designed for efficient vertical transportation up to 125 feet, which is about the limit of service called for on steel assembly work. The rivets used on this job are 1⅛ inches in diameter and of extra length. The flexible tubing has an inside diameter of 2 inches, which provides for sufficient clearance around the rivet head to prevent the delivery velocity from becoming undesirably high.

This system, which is manufactured under the trade name of Penflex Pneumatic Rivet Passer, lays claim to a number of advantages, foremost among which are greater safety to workmen and lower costs. Every rivet goes where it is intended, and can be delivered direct to points of use regardless of their inaccessibility. Uncertainties of the more spectacular but hazardous practice of hand-passing are eliminated. Heat losses sustained by rivets during transmission are lower, and scale is removed from them because they come in contact with the walls of the tubing while in transit.

NEW PUBLICATIONS

Anyone interested in railroad statistics will find *Railroad Facts No. 12* an invaluable source of information. It is published by the Western Railways' Committee on Public Relations, 105 West Adams Street, Chicago, Ill.

In Bulletin 18D, recently published, the Ruemelin Manufacturing Company, Milwaukee, Wis., illustrates and describes its full line of compressed-air drying equipment. Copies of it may be obtained from that company upon request.

Diesel Hand Book, an illustrated, 352-page work by Julius Rosbloom, has recently been issued by Diesel Engineering Institute, 443 Hoboken Ave., Jersey City, N. J. Written in simple language, in the form of questions and answers, it is designed as a practical guide for engineers and students of modern diesel engineering. It includes land, marine, locomotive, aero, automotive, and portable types of engines. The book has the official endorsement of the United Licensed Officers, U. S. A. It is obtainable from the publisher at $5 a copy, prepaid.

Improvements in Victor Automatic Force-Feed Lubricators for bearings have been announced by the Victor Lubricator Company, Chicago, Ill. The most important of these are the substitution of cadmium-plated steel for brass in their construction to reduce loss through breakage; a new sight feed that makes visible at all times the rate of oil feed and the supply in the reservoir; a larger filler tube that permits faster and easier charging; and a new valve control inside the filler tube that prevents tampering with the lubricator once it is adjusted at the time of installation. Full details about the Victor Automatics may be obtained from the aforementioned company.

For the first time since it began manufacturing V-Flat Belts, The Dayton Rubber Company, Dayton, Ohio, has published a comprehensive, 15-page catalogue on the subject. The booklet contains a description of the belts with suitable illustrations, and presents in detailed and simplified form the company's complete range of V-Flat drives for all ratings up to 300 hp. and more for general industrial use where large speed ratios and very short centers are involved. The tables are such that the correct drive for any horsepower can be selected at a glance no matter whether it be for a new installation or a change over. V-Flat Belts need no introduction here, as they have been employed for years in connection with small machines of various kinds, including refrigerators, pumps, and compressors. Their success in that field has led to V-Flat drives of larger sizes which, together with the others, are covered in Catalogue No. 160. Persons interested can obtain a copy from The Dayton Rubber Company.

ALGERNON S. UHLER

ALGERNON SIDNEY UHLER, vice-president of Ingersoll-Rand Company, died September 5 at his home in Westport, Conn., after an illness of several months. He was 60 years old.

Mr. Uhler spent virtually his entire adult life promoting the use of compressors and allied equipment in the gas industry and in the mining and contracting fields, and his duties took him to various parts of the world.

He was born on July 11, 1874, at Germantown, Pa. His parents, Algernon Sidney Uhler and Anna Eckhard Uhler, were also native Pennsylvanians.

After attending the mechanical engineering department of the University of Pennsylvania, Mr. Uhler, in 1894, became an apprentice in the factory of the Ingersoll-Sergeant Drill Company at Easton, Pa. For a time thereafter he worked for the Dravo Contracting Company in Pittsburgh, and then entered the employ of the Rand Drill Company in the same city as a sales engineer. He remained continuously with that firm and its successor, Ingersoll-Rand Company, from that time on.

During his service in Pittsburgh, Mr. Uhler devoted a considerable portion of his time interesting gas producers and allied industries in the applications of compressors. From Pittsburgh he was sent to Butte, Mont., to become manager of the branch sales office there. Butte was at the time one of the foremost mining camps of the world and was somewhat of a proving ground for rock drills. Mr. Uhler accordingly, gained an intimate knowledge of this class of machinery and became recognized as a rock-drill specialist. Because of his capabilities along this line, he was sent to South Africa to assume charge of the Ingersoll-Rand office at Johannesburg, center of the gold-mining district.

ALGERNON S. UHLER

After several years of foreign service, Mr. Uhler was recalled to the company's executive offices in New York City and appointed manager of rock-drill sales. He remained in that position until 1924, when he was placed in charge of sales of complete compressed-air plants and equipment to contractors and other large-scale users of such machinery. In 1928 he was made a vice-president, his duties remaining the same.

His health first began to fail nearly two years ago, but he continued to spend a portion of his time in his office until a few months ago, when his condition became too serious to permit this.

Mr. Uhler is survived by his widow, Mrs. Ida Milton Uhler, and by his mother. Funeral services were held September 7, at Norwalk, Conn.

CONCRETE-CURING METHODS TESTED ON ROADBUILDING JOB

VARIOUS methods of curing concrete were tried out on a roadbuilding project by the Georgia State Highway Board not long ago in order to determine how a thin layer of neat-cement paste, applied with compressed air, would compare with coverings normally used for that work. It was argued that the fine particles of cement forced into the pores of the concrete would seal them and thus serve the double purpose of preventing the escape of the moisture necessary to effect curing, and, subsequently, of reducing the measure of moisture penetration.

Most of the road was cured by keeping wet burlap on the concrete for 24 hours and then replacing it with a 3-inch layer of wet earth that was allowed to remain in position for ten days. The remaining sections were cured, respectively, by strips of wet burlap left in place for a 24-hour period and by a film of neat cement which, unlike the other materials, did not have to be removed. One bag of cement was used for each 100 square yards of surface covered, and the paste was applied as soon as the concrete had been laid. The machinery required for the work consisted of a small compressor and of a mixing tank provided with an agitator to assure a mass of uniform consistency. Air at 45 pounds pressure was needed to force the cement out of the tank and through a hose to a spray nozzle, where it was atomized by a stream of compressed air. The paste was applied in a layer thick enough to cover the surface adequately, but not so heavy as to bury the top sand grains and produce a slick film.

When the concrete in the different sections was four weeks old, 6-inch-diameter cores were taken from each and tested the same day to determine their strength under compression. The results were as follows: the pavement cured with burlap and with earth and water, 3,388 pounds per square inch; neat cement, 2,961 pounds per square inch; and wet burlap only, 2,716 pounds per square inch. All the road sections used for test purposes were constructed during very hot, dry weather. The pavement was of 9-6-9 inches thickness with a longitudinal center joint and transverse joints at 50-foot intervals. The concrete was made from crushed granite and quartz sand aggregates and contained 1.45 barrels of cement to the cubic yard.

The foregoing findings were substantially corroborated by another test that is said to mark something of a departure in work of this kind and that has interesting possibilities. On the general assumption that a cure, to be effective, must hold the moisture in the concrete, and with the knowledge that the electrical resistance of concrete varies with the moisture content—the resistance being low for moist concrete and high for dry concrete, the engineers proceeded to develop equipment that would enable them to measure in terms of electrical resistance the effectiveness of the three methods of curing.

After first trying electrodes of ½-inch strips of galvanized iron embedded in the concrete, contact was satisfactorily established by means of two 4x4-inch wooden blocks one end of each of which was covered with sheet copper. These were set on the pavement with the metal resting on interposed layers of cheesecloth saturated with salt water. The object of the cloth was to take up the surface irregularities and through the brine to assure good contact with the copper plate. With these blocks it was possible to obtain reasonably uniform results. All the measurements were made within a strip 3 feet wide along the edge of the road and at points 3 feet apart; and they were numerous enough to assure an average that would fairly represent the entire area. The pavement being cured with earth and water was uncovered for some distance on either side of the contact points before the resistance measurements were taken.

In all cases there was a pronounced drop in the resistance during the course of a heavy rain that fell during one afternoon and night.

The spray method of curing concrete was suggested by F. A. Hipple of Atlanta, Ga.

Industrial Notes

A patent has been obtained on a pneumatic device that is designed to cushion the gate-closing action of motion-picture projectors and to counteract the force of the shutting spring. This is effected by means of a small built-in compressed-air cylinder.

Wood putty of any desired shade for repairing furniture and automobile bodies, for use in pattern-making, etc., is obtainable in tubes or cans for domestic and industrial use. It is produced by the Las-Stik Manufacturing Company, Hamilton, Ohio, and is said to be nonshrinkable and highly adhesive.

Major trunk lines in the United States have been known to spend as much as $50,000 a year for the item of sand, which has to be applied to the tracks to give the driving wheels better traction. It is frequently blown on the rails by means of a jet of compressed air that is operated by the engineer from his position in the cab.

No-Glare is a sky-blue liquid of recent production that is used for coating window glass to protect workers from the sun. It can be applied by brush or paint spray, and is said to leave an even film that permits 94 per cent of the light to penetrate while preventing glare and the transmission of a goodly percentage of heat. One coat will last a summer, and can be removed with water.

SLATE IN COLORS TO SUIT THE HOUSEBUILDER

THE present-day demand for color in roofing materials has affected the slate industry in some quarters to such an extent that it has had to take steps to remedy the situation. In Great Britain, the serious competition offered by composition shingles and tiles that are attractive in color as well as fireproof has induced five English slate quarries to combine in an attempt to discover a process whereby slate could be made pleasing to the eye. It is therefore of interest to learn that this has been accomplished.

Two Reading college professors, according to information from abroad, are responsible for the coloring matter used and the method of its application. No facts regarding either are divulged other than that "the tints are painted on the slates and then sprayed by a fixing agent." The latter is said actually to harden the surface of the material itself, which may also be wood, brick, etc. Slates so coated do not lose their roughness, which adds so much to the appearance of the finished product. Severe tests, which have even included boiling in acids, have demonstrated the wearing quality and the adhesiveness of the colored film.

Coating surfaces of condensers with soap makes them better drop collectors. That, at least, is the experience of several engineers who have been experimenting with oleic and stearic acids which are important ingredients in soap. A trace of either of them on copper, brass, nickel, or stainless steel was found to increase misting. The use of these acids, which are not easily washed off, may, as these investigators see it, lead to a considerable reduction in the size of surface condensers.

Press reports from Canada have it that significant discoveries affecting the aniline-dye and high-explosives industries have been made at the plant of the Manitoba Creosote Company in the vicinity of Winnipeg, Manit. Experiments conducted there have resulted in a new process for the extraction from coal tar of the oils that are the base of high explosives, aniline dyes, perfumes, and of many pharmaceutical products. The claim made for it is that it yields more values than does the German method which, so far, has been the most efficient.

Rubber paving blocks and markers are a feature of the Mersey Tunnel, or Queensway as it has been named, between Liverpool and Birkenhead, England, which was recently opened to traffic. The amber-colored markers divide the lanes of travel, while the paving blocks, which are in the nature of an experiment, are designed to reduce vibration at the Birkenhead end where the structure passes over the Mersey Railroad Tunnel. The blocks are 2 inches thick and cover an area of 18,000 square feet. The remaining 432,000 square feet of floor space is paved with blocks of cast iron.

A thin film of metallic or nonmetallic substance in powdered form on the inner surfaces of the iron molds used in the centrifugal casting of iron pipe will, it is said, eliminate the chill effect that is normally induced. Admixed with compressed air, the powder is applied to the mold wall by a spray nozzle a few seconds before the molten metal is permitted to strike it. The thickness of the coat has to be controlled to a nicety to get best results and depends upon the material that is used. This may be ferrosilicon, kaolin, talc, magnesite, ferromanganese, mica, etc.

Compressed air stored in cylinders can be depended upon in an emergency to operate a riveting hammer or other pneumatic tool. This was proved not long ago in the case of a hurry-up repair job on a power-line standard that was damaged as the result of a derailment on an electrified line. Lacking a portable compressor at the scene of the accident, two of the train's air cylinders served to supply power to drive 64 rivets and to ream the rivet holes. For this purpose the cylinders were provided with two 10-foot lengths of hose; and regulating valves maintained a working pressure of 90 pounds. A record was kept of the air consumption, and this showed that an average of 11 cubic feet of air was required to drive one ⅞-inch rivet and that eight holes were reamed with 100 cubic feet in less time than the crew could have reamed one hole by hand.

Something new and unusual in airplanes comes from Austria where a scientist, after studying the flight of insects, has invented a plane that has no rudder, as we know it, and no propeller. The craft has a length of about 38 feet, and has two 13-foot forward wings and two rear ones, 10 feet long, which serve as propellers. These wings, the underside of which is made of rubber, are divided into numerous pneumatic cells which are made to pulsate by alternately evacuating them and charging them with air. The wings are attached to the metal frame by elastic joints, and have a stationary leading edge and a movable trailing edge so that they can be manipulated to control the craft. The inventor claims that the flying machine can rise and descend almost vertically, hover apparently motionless, and travel forward and backward. How much speed the airplane can make with its pulsating wings and 10-hp. motor is not divulged.

PNEUMATIC TIRES OF SYNTHETIC RUBBER STAND UP IN SERVICE

AUTOMOBILE tires of synthetic rubber are an accomplished fact, according to E. I. duPont de Nemours & Company, Wilmington, Del., producer of the raw material, and the Dayton Rubber Manufacturing Company, Dayton, Ohio, maker of the tires. Severe laboratory and road tests, the announcement reads, have proved them to be equal and in some respects even superior to tires of natural rubber. It is claimed, for example, that the artificial rubber is more resistant to the swelling action of gasoline, kerosene, and other solvents, as well as to the destructive action of the weather; that it possesses a high degree of elasticity and tensile strength; and that it is tough and durable. Heat only is required to vulcanize it; and it can be manufactured into tires with the same machinery now in use for that purpose.

Du Prene is the name of the synthetic rubber which, among other ingredients, is compounded of coal, limestone, salt, and water, all of which are to be had in abundance in the United States. As natural rubber has to be imported, the significance of this discovery cannot be overestimated. Already steps have been taken to use Du Prene for commodities other than tires.